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CONTENTS

29 August 1990

SCIENCE & TECHNOLOGY POLICY

- Major S&T Policy Issues To Be Faced in the 1990's Discussed
[Yang Lincun, Qiu Chengli; *LIAOWANG ZHOUKAN*, 7 May 90] 1

SCIENTISTS, SCIENTIFIC ORGANIZATIONS

- Research Institute of Atomic Energy Sciences Described [Wang Min; *CHINA PICTORIAL*, No 2, 90] .. 4

ADVANCED MATERIALS

- Special Report on New Materials R&D in 863 Plan 6
- Introduction, Overview [Zeng Hanmin; *KEJI RIBAO*, 19 Jun 90] 6
 - Diamond Thin-Film Technology [KEJI RIBAO, 19 Jun 90] 7
 - Ion Implantation Technology [KEJI RIBAO, 19 Jun 90] 8
 - High-Performance Resin Composites [KEJI RIBAO, 19 Jun 90] 8
 - New Functional Materials [KEJI RIBAO, 19 Jun 90] 9
 - High-Performance Structural Materials [KEJI RIBAO, 19 Jun 90] 10
- China's First Pulsed Reactor Passes Safety Checks [GUANGMING RIBAO, 22 Jun 90] 11
- 1989 Achievements, Future Development in Metallurgical Science, Technology
[Tao Jin; *GANGTIE*, Mar 90] 11
- Domestically Developed LBO Crystals Pass Accreditation
[Jia Baoliang; *JIEFANG RIBAO*, 13 Jul 90] 16

BIOTECHNOLOGY

- Expression of Human Interleukin 4 in E. Coli
[Li Chen, Zhang Zhiqing, et al.; *ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI*,
No 3, Jun 90] 17
- The Cloning and Expression of Invasion-Associated Protein Antigens of Shigella Flexneri Serotype 2a
[Liu Xuebo, Kong Xiangying, et al.; *ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI*,
No 3, Jun 90] 17
- Expression of HLA I and II Antigens on Hepatocyte Membrane Compared With Infectious Status in
Chronic Asymptomatic Hepatitis B Virus Carriers
[Hou Jinlin, Luo Kangxian; *ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI*,
No 3, Jun 90] 18
- Fc Receptor Expression in Patients With Chronic HBV Infection
[Li Yali, Kong Xiantao, et al.; *ZHONGHUA CHUANRANBING ZAZHI*, No 2, May 90] 18
- Preparation of Human Minisatellite DNA Probes
[Guo Guangming, Qiu Xinfang, et al.; *YICHUAN XUEBAO*, No 3, Jun 90] 19
- Quantitative Analysis of the DNA Genome of HBV by Blot-Hybridization
[Bai Wei, Jing Guozhong; *ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI*,
No 3, Jun 90] 20
- Detection of Epidemic Hemorrhagic Fever Virus Antigen and IgG in Neutrophils of Patient With
Epidemic Hemorrhagic Fever
[Zhu Xiangxiu, Gao Cong, et al.; *ZHONGHUA CHUANRANBING ZAZHI*, No 2, May 90] 20
- A Novel Type of Phase Variation Regarding Integrated and Free States of Plasmid pFDX163 in *Bacillus*
stearothermophilus CU21 [He Xiaosong, Shen Renquan, et al.; *YICHUAN XUEBAO*, No 3, Jun 90] . 21
- Study on Immunogenicity of HBsAg Bound to Anti-HBs of Different Affinities
[Qian Lisheng, Zhang Deqiang, et al.; *ZHONGHUA CHUANRANBING ZAZHI*, No 2, May 90] 21
- Study on the Molecular Forms of Plasma Fibronectin in Patients With Severe Viral Hepatitis
[Guan Peilong, Wang Weiye, et al.; *ZHONGHUA CHUANRANBING ZAZHI*, No 2, May 90] 21

A New Single Point Mutation at the Initiation Codon (ATG-AGG) Identified in Amplified Genomic DNA of a Chinese With β -Thalassaemia [Xie Shensi, Tan Rongan; ZHONGHUA YIXUE ZAZHI, No 5, May 90]	22
Establishment of CPE and Plaque Methods for Rabies Virus Titration [Li Hongling, Li Hemin, et al.; ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI, No 3, Jun 90]	23
Screening of the Catalase Producing Thermophilic Microorganisms and the Conditions for Enzyme Productions [Zhou Yi, Yan Zizheng, et al.; WEISHENGWU XUEBAO, No 3, Jun 90]	23
Rapid Identification of Mycobacterium Tuberculosis and Other Mycobacteria With Mycobacterium Tuberculosis Whole Chromosomal DNA Probe [Wu Xueqiong, Zhuang Yuhui, et al.; WEISHENGWU XUEBAO, No 3, Jun 90]	24
Cell Selection of the Tobacco Mutant Resistant to Black Shank Disease [Zhou Jianmin, Liang Sixin, et al.; YICHUAN XUEBAO, No 3, Jun 90]	24
Study on Antifreeze Protein in Fishes II. The Cloning of Antifreeze Protein Gene cDNA of Pseudopleuronectes Yokohamae and Its Expression in E. coli [Jiang Yaoqing, Chen Xiongfang, et al.; YICHUAN XUEBAO, No 3, Jun 90]	25
Determination and Assessment of Respiratory Resistance for Aircraft Oxygen Equipment [Ma Ruishan, Ni Heying, et al.; JIEFANGJUN YIXUE ZAZHI, No 3, Jun 90]	25
A Preliminary Study on Stability of the Form I Plasmid of Shigella Sonnei [Liu Wei, Wang Bingrui, et al.; ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI, No 3, Jun 90]	26

CHEMICAL ENGINEERING

Improved Fuzzy Controller Used in Polymer Plant [Dai Zhongda, Zhang Zengke, et al.; ZIDONGHUA XUEBAO, May 90]	27
--	----

COMPUTERS

Further Reports on Computer Virus Prevention, Outbreaks	28
Papers at Conference on Computer Security [Shang Mu; JISUANJI SHIJIE, 25 Jul 90]	28
Situation in Shaanxi Province [Bai Yu; JISUANJI SHIJIE, 25 Jul 90]	28
Situation in Guangxi Province [Zhang Keqian; JISUANJI SHIJIE, 25 Jul 90]	28
Situation in Shanghai Municipality [Liu Bin; JIEFANG RIBAO, 29 Jul 90]	28
Software Developments Reported	29
Engineering Modelling & Simulation System [Li Dasheng; JISUANJI SHIJIE, 11 Jul 90]	29
Conceptual Design Expert System Tool [Wang Qun; JISUANJI SHIJIE, 11 Jul 90]	29
Programmable Array Logic Tool [Li Rukun; JISUANJI SHIJIE, 11 Jul 90]	29
Optical CAD System [Xuan Gang, Han Yun; JISUANJI SHIJIE, 18 Jul 90]	30
BIOS 4.0 Operating System [Gao Yuqian; JISUANJI SHIJIE, 18 Jul 90]	30
Key State Lab Accredited [JISUANJI SHIJIE, 25 Jul 90]	30
New Corporation Established [Ji Hongguang; KEJI RIBAO, 26 Jul 90]	30

FACTORY AUTOMATION, ROBOTICS

Developments in Underwater Robots by Shenyang Institute [Ji Ren; CHINA DAILY, 10 Aug 90]	31
--	----

LASERS, SENSORS, OPTICS

Monostatic Radar Cross Section for Reflector Antennas [Deng Shuhui, Ruan Yingzheng; DIANZI KEXUE XUEKAN, Jul 90]	32
Improved Perturbation Analysis of Millimeter-Wave Dielectric Grating Antenna [Xu Shanxia, Wu Xinzhang; DIANZI KEXUE XUEKAN, Jul 90]	33
Electron Orbits and Variation Character of γ in Electromagnetic Wigglers [Zhou Shi'e, Feng Bibo, et al.; ZHONGGUO JIGUANG, No 3, Mar 90]	33
Temporal, Spatial, Energy and Polarized Properties of an Injection-Locked Copper Vapor Laser [Ren Hong, Wo Mingzhen, et al.; ZHONGGUO JIGUANG, No 3, Mar 90]	34
Investigation of Picosecond Double-Wave Band Short Cavity Dye Lasers [Qian Liejia, Liu Yixian, et al.; ZHONGGUO JIGUANG, No 3, Mar 90]	34

MICROELECTRONICS

Computer Aided Analysis of a Simple Optoelectronic Integrated Circuit [Chen Weiyu, Hu Lizhong, et al.; BANDAOTI XUEBAO, Jun 90]	35
GaAs Metal-Insulator-Semiconductor Heterojunction FET Developed [Yang Qinqing, Gao Junhua, et al.; BANDAOTI XUEBAO, Jul 90]	35

SUPERCONDUCTIVITY

Superconducting Properties and Structure of $\text{YBa}_2\text{Cu}_{3-x}\text{Sn}_x\text{O}_{7-y}$ System [Wang Yuxia, Ruan Yaozhong, et al.; DIWEN WULI XUEBAO, No 3, May 90]	36
The Superconductivity and Anomalous Magnetization of the $\text{Ti}_4\text{Ba}_3\text{Ca}_3\text{Cu}_4\text{O}_y$ [Cao Xiaowen, Huang Sunli, et al.; DIWEN WULI XUEBAO, No 3, May 90]	36
The Magnetization and H_{c1} of the High T_c Oxide $\text{Bi}_{2-x}\text{Pb}_x\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_y$ Bulk Superconductors [Cao Xiaowen, Huang Sunli, et al.; DIWEN WULI XUEBAO, No 3, May 90]	36
Study on Zero Resistance at 118K in (Bi, Pb)-Sr-Ca-Cu-(O, F) Superconductor [Gao Xiaohui, Wu Xiaolin, et al.; DIWEN WULI XUEBAO, No 3, May 90]	36
Relation Between the Change of Oxygen Deficiency and Oxygen Hole and the Transition of Structure for $\text{Y}_1\text{Ba}_2\text{Cu}_3\text{O}_{7-\delta}$ [Su Wenhui, Jin Changqing, et al.; DIWEN WULI XUEBAO, No 3, May 90]	37
Millimeter Wave Surface Impedance of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ Sheets Measured by a High- T_c Superconducting-Dielectric Resonator at W-Band [Zhou Shiping, Bao Jiashan; DIWEN WULI XUEBAO, No 3, May 90]	37

Major S&T Policy Issues To Be Faced in the 1990's Discussed

90CE0133A Beijing LIAOWANG ZHOUKAN
[LIAOWANG WEEKLY] in Chinese No 19, 7 May 90
pp 40-41

[Article by Yang Lincun [2799 2651 2625] and Qiu Chengli [6726 2052 0448]: "Major S&T Policy Issues to be Faced in the 1990's"]

[Text] With the arrival of the 1990's, S&T development in China is facing new challenges and opportunities. After reviewing China's S&T policies in the 1980's, the experts and departments in charge believe that it would be tremendously significant for our effort to speed up modernization in China if we raise a number of issues and responses without delay based on the characteristics of S&T development in the 1990's.

Guided by the spirit of the 3d Plenum of the 11th CPC Central Committee, the CPC Central Committee and the State Council led the army of S&T personnel in breaking free from the strangle-hold of ultra-leftist thought in the late 1970's and early 1980's and brought order out of chaos. There were major breakthroughs in the acquisition of S&T knowledge. For instance, it was clearly established that science and technology are productive forces and that S&T personnel are part of the proletariat, etc. These breakthroughs in theory and understanding paved the way theoretically and ideologically for the unveiling subsequently of the overall principle of S&T development—"economic construction must rely on science and technology and science and technology must be oriented toward economic construction"—and for the introduction of a range of major S&T policies, including the improvement of the conditions of service for S&T personnel, the mobilization of their enthusiasm, and S&T structural reforms. These important ideas and viewpoints, which crystallized in the early 1980's, prevailed through the entire decade.

On the basis of their research and studies, experts think we have yet to examine the following issues in earnest and arrive at a consensus so that we can put forward a response:

1. How to Implement the Key Policy of "Making S&T Work the Centerpiece of the Economic Development Strategy."

This major strategic measure put forward by the 13th National Party Congress shows the resolve of the CPC Central Committee and State Council to shift from a speed-oriented economic development model to one oriented toward efficiency. This enormously significant strategic shift has yet to be realized. This is mainly because a large number of leaders at all levels do not yet truly understand the colossal role played by S&T progress in economic and social development. Also, since the contributions of S&T progress to social and economic development are multi-level, multi-faceted, and multi-dimensional, the implementation of this

strategy is a vastly complex matter. Basic research, technological development, and the development of high-tech industries all take place at different levels. Their work methods are totally different. Regions, trades, and enterprises also differ in their forms of technological progress and S&T demands. Given the existing system, it is a daunting job to make the Chinese economy S&T-based within a short time. It must go through a difficult process. But while the process is difficult, this fundamental strategic shift is inevitable, being determined by the objective laws of economic development. In the 1990's, we should make endless efforts to accelerate the shift.

2. Gradually Develop New Operating Mechanisms for S&T progress and Make the Most of State Planning and Market Regulation Correctly.

China will follow a socialist planned commodity economy on a long-term basis in future. This determines that both state planning and market regulation will play a role in the nation's S&T progress. Accordingly we must examine in earnest ways of adopting the operating mechanisms for S&T progress. At what levels and within what scope is state planning more suitable than market regulation, and vice versa? What are their respective strengths and limitations? And how can we integrate and coordinate them organically? At present there is a greater measure of consensus on basic research and public interest-type of research: We believe market demand has no effects on them. Therefore, the state should support these kinds of research. Much more problematic are the respective roles of state planning and market regulation in technological research and development in industries involved in the production of commodities. Where should the two meet in these kinds of research? How should the two be reconciled? Our insufficient understanding on these issues has already affected S&T work today. If this problem remains unresolved, it will make our future work even more haphazard.

3. Clarify the Role and Place of the State, the Industry, the Enterprise, and the Scientific Research Organization in S&T Progress and Their Division of Labor. Allocate and Reorganize S&T Resources Rationally.

As the economy further develops and reform intensifies, gross irrationalities in the structure and allocation of scientific and technical forces are becoming clearer and clearer. For instance, some basic research organizations duplicate one another or are too fragmented. Within the trades, technological development organizations are not working as they should. Overall, there is a surfeit of research organizations, but such abundance is accompanied by a shortage in some areas. The status of private S&T organizations has not been properly established. Nor has their conduct been formalized. The technological development forces of enterprises, particularly small and mid-sized enterprises, are meager. There is also a regional imbalance in technological forces. All these illogical circumstances have resulted in tremendous

waste and are no longer compatible with the development of a socialist commodity economy. It will be a long-term and daunting task for the 1990's to properly deploy and reorganize the existing scientific research organizations and personnel through sound policies and measures based on the characteristics of scientific and technological work of research organizations at different levels, in different trades, and under different ownership systems.

4. S&T Progress in Agriculture

The place of agriculture in the national economy is known to all. The state accords top priority to agricultural S&T progress. How to use science and technology to generate a boom in agriculture is a long-term and daunting mission. Since agricultural production is intimately related to natural conditions, agricultural S&T progress is clearly unique. Agricultural S&T embraces basic research, applied research and development, the dissemination of services, and other work at all levels, which no doubt complicates progress in S&T agriculture. For instance, some agricultural S&T projects are highly risky and time-consuming and have a low success rate. Accordingly, they require steady investment and support over a long period of time. Right now there is insufficient investment in agricultural S&T, which is bound to hurt the momentum of agricultural development. Agricultural technological dissemination services involve hard work and are poorly paid, resulting in a high turnover rate among the corps of workers. As agricultural development reaches an appropriate scale, how to create new mechanisms to help science and technology bring prosperity to agriculture, how to establish a new agricultural technological service system and other questions will assume increasing significance over time.

5. Enterprise Technological Progress

The enterprise is the final vehicle of technological innovation. Only through the enterprise can science and technology in the production area be converted into products and profits. Without enterprise technological progress, one cannot even begin to talk about science and technology as an engine of economic development. Nowadays enterprises are not motivated to pursue technological progress. Nor are they under pressure to do so. Therefore, they have little enthusiasm for S&T progress. With limited self-accumulation, enterprises cannot afford sufficient investment in technological R&D. Since intermediate testing is woefully inadequate, scientific research achievements are not converted into productive forces. As yet enterprises are not yet operating on a scale large enough to enable them to take on the risks associated with technological involvement. On the other hand, the state has not been giving effective support to the enterprise's technological pursuits. Confronted with this array of problems, in the 1990's we must experiment with and search for new mechanisms of technological progress in enterprises under a socialist commodity economy, gradually create a policy environment and market environment favorable to stimulating enterprise

technological progress, and step up state guidance of and support for such progress. Only when technological progress becomes a major factor of enterprise development can the national economy truly rely on S&T progress.

6. How to Support the Development of High-Tech and New-Tech Industries.

Owing to years' of steady investment, China boasts a S&T army surpassing that of most developing nations and actually matching or approximating advanced world standards in some areas. The development of high- and new-tech industries will be an important means of making the most of our current S&T forces in the service of the national economy. The development of high- and new tech industries in the 1980's proves that there is vast room and tremendous potential for their development. Reform and the open policy have also provided an international market and opportunities for such development. Facts prove that the prospects for high- and new-tech industries in China are bright. Be that as it may, such industries do differ from traditional industries in that they rely more on people and require more flexible operating methods and a more relaxed external environment. What we should do is to review our work in the 1980's and use the lessons thus learned to hammer out new mechanisms for developing high- and new-tech industries suited to China's conditions, enhance their vitality, intensify the government's macroeconomic management and guidance and accelerate the development of China's high- and new-tech industries.

7. How to Further Mobilize the Initiative of S&T Personnel

In the 1980's a lot of work was done with a measure of success to implement the policy on intellectuals, improve the status and conditions of service of S&T personnel, and mobilize their enthusiasm. This was mainly accomplished by two means. First, administrative methods such as the offering of rewards, evaluation of job titles, and the improvement of wages were used to improve the conditions of service of S&T personnel. As far as objective effects are concerned, although these methods went some way toward solving the conditions of service problems of some S&T personnel, they are of limited use in mobilizing the initiative of S&T personnel. On the contrary, they have fostered the growth of egalitarianism, exacerbating the problem of "eating from the big rice pot" in distribution. The achievements of the 1980's were also effected by such reforms as "double liberalization" and "invigoration." Many S&T personnel, particularly those who joined private S&T research organizations, have seen an improvement in their living standards and status. They did substantial work and had a successful career. This method, which is totally different from the practice of government running everything, has been remarkably successful in mobilizing the initiative of S&T personnel. But it has given rise to a number of problems like unequal distribution of costs and benefits and unequal distribution. The practice

of the 1980's shows that while both approaches have worked in their own ways, there are also some problems. As the two approaches will continue into the 1990's, a leading issue we will face is how to make the most of the two approaches fully and sensibly so that they supplement each other harmoniously. Many outstanding people who graduated from college in the 1950's will retire one after another in the 1990's, which may well result in a gap in the ranks of qualified personnel. We should pay utmost attention to this problem and promptly adjust our policy if necessary by continuing to use the services of some outstanding personnel who have retired. At the same time, we must accelerate the training and employment of young people. In the future the professional, ideological and psychological needs of S&T personnel as well as their living conditions must be examined more closely. By using a combination of moral encouragement, administrative measures, economic leverage, and other means, we should gradually establish a body of policies and a social economic climate favorable to unleashing the initiative of S&T personnel.

8. Create a Multi-Level and Multi-Faceted S&T Funding System

Lack of funding is one of the biggest impediments to S&T progress in China. Much useful experimentation was already conducted back in the 1980's in S&T development fund-raising. In the 1990's we must do our best to translate theories and ideas into reality, including the improvement of the management of state investment, S&T loans, venture capital, fund-raising at home and abroad, and overseas loans. All these funding activities must be institutionalized and standardized. Only with the establishment of a funding guarantee system can the S&T enterprise develop soundly.

9. Correctly Handle the Relationship Between the Import of Technology and Self-Development.

This topic was a very controversial one back in the 1980's but has never been fundamentally resolved. In the past 10 years China has imported some technology and equipment, part of which proved to be a big boost to the economy after being absorbed and assimilated. Nevertheless many problems remain. At the heart of the issue is that imported technology is divorced from domestic R&D and even affects and interferes with the normal conduct of scientific research within the country. For its part, scientific research within China has also failed to give the import of technology effective support and services. There are no effective linkages between the two. In short, the import of technology has not turned out to be a major tool of improving China's self-development capacity in science and technology. In the 1990's we must continue to analyze the economic, institutional, and scientific and technical reasons for this and gradually search for a way to combine the import of technology with the enhancement of self-development capabilities.

10. Continue to Create and Improve China's S&T Legal System.

The further intensification of reform and the open policy, the rapid development of S&T, the increasing commercialization and rapid conversion of S&T achievements into products—all this has put forward urgent demands on S&T legislative work. A S&T legal system is badly needed. While notable progress has been made in that area in the 1980's, we must continue to broaden the scope in the 1990's to make full use of law as a guardian and catalyst of science and technology. A number of mature S&T policies and relevant regulations should be improved and upgraded as law. Apart from implementing such S&T legislation as the "Technology Contract Law" and the "Patent Law," we must quicken the formulation of laws and administrative regulations favorable to S&T development and progress and gradually write into law the contents of the training, management, and utilization of S&T personnel.

Research Institute of Atomic Energy Sciences Described*40100069 Beijing CHINA PICTORIAL in English
No 2, 1990 pp 30-34*

[Article by Wang Min: "China's Atomic City—A Visit to the Chinese Research Institute of Atomic Energy Sciences"]

[Excerpts] Recently we visited the Chinese Research Institute of Atomic Energy Sciences. Known as the "Atomic City", the institute is situated at the foot of the Yanshan Mountains in the southwestern suburbs of Beijing.

Sun Zuxun, the president of the institute, warmly received us. "Before the middle of the 1970's, the institute was a strictly confidential unit," said the president. "Later it was opened to visitors and gradually became a civil institute mainly engaged in basic and applied research in nuclear physics, radiochemistry, and nuclear reactors." It also undertakes research in analytic chemistry, nuclear electronics, the treatment of waste gas, water and industrial residue and protection against nuclear radiation. The institute manufactures radioisotopes, accelerators and nuclear sounders. It has three nuclear research reactors, ten accelerators, four zero-power reactors, two isotope electromagnetic separators, various "hot" laboratories for making radioisotopes, laboratories for research in radiochemistry and the co-bo radiation facilities.

In 1950, China established the Modern Physics Research Institute under the Chinese Academy of Sciences, which was later renamed the Chinese Research Institute of Atomic Energy Sciences. Professor Wu Youxun together with some well-known scientists such as Qian Sanqiang, Zhao Zhongyao, Wang Ganchang and Peng Hengwu, who has returned from abroad, initiated research into atomic energy. During the first ten years, they concentrated their efforts on the research and manufacture of nuclear weapons.

The institute has established 11 branches and trained 6,000 scientific workers. Almost every unit related with atomic energy research has scientists from our institute. It is true that the institute is the birthplace of China's atomic energy.

Given the new international situation and the needs of modernization, China decided to devote its major efforts to developing a civilian nuclear industry. The institute made the second revolution—the peaceful use of nuclear energy. It joined the others in building nuclear power stations and developing the technology of isotopes and radiation.

One night during our visit, we were led to a 40-square-meter hall. In the middle of the hall was a well

covered by a piece of plexiglass. We were told that the tube-shaped container hanging in the well was the first micro-reactor for civil use in China. When the reactor was activated, blue rings of light illuminated the dark room. A scientist told us that the micro-reactor filled with only one kilogram of enriched uranium can, through fission, create neutrons at a flux rate of 1,000 billion per second, per square centimeter. The micro-reactor can be used to analyze the behavior of neutrons and produce short-lived isotopes. It can also be used for research in such diverse fields as: geochemistry, celestial chemistry, the sciences of environment and life, archaeology, and the analysis of forensic evidence. Designed and manufactured by the institute, the micro-reactor is cost effective and safe. It does not pollute the environment and is highly efficient. Today, only a few countries have this type of reactor. Some countries have held talks with China about importing this technology.

Although China is among the few countries possessing nuclear capabilities, it does not have a single nuclear power station even though 400 such stations have been built worldwide. In 1980, Professor Dai Chuanzeng, a well-known scientist and honorary president of the institute, took the lead in studying the safety of nuclear power and the necessary conditions for its safe use. Scientists renovated the heavy water reactor, which has played an important role in China's first nuclear test, thereby prolonging its service life. The reactor was used for testing the nuclear elements to be employed in the first nuclear power station built by a developing country. With the completion of the first phase of the project at the end of 1989, a set of generators with a capacity of 300,000 kilowatts will be put into operation.

In the 1980's, China began to use the technology of isotopes and radiation in industry and for commercial production. The isotope products and electron beams made by the institute are up to world standards. The institute's technology in processing products with gamma-ray radiation has also approached the international standards.

Isotopes are an indispensable product for modern medicine. They are used by 1,200 hospitals and medical institutions in China. Seventy percent of the isotopes required are supplied by the Chinese Research Institute of Atomic Energy Sciences. The institute also produces 200 kinds of radioisotopes and 40 other isotope compounds for medical use.

The institute designed and built a 300,000-curie co-bo radiation facility, enabling a wider use of radiation in production.

The institute is researching the fast breeder reactor power station, known as the second-generation of nuclear power stations. It boasts a tandem accelerator, the largest electrostatic accelerator in China, which indicates that China's research in atomic physics has reached

that of advanced nations. After six years' research on thermonuclear fusion, the institute opened up a path for the development of ideal sources of energy.

On the question of the health of scientific workers who deal with radioactive materials every day, the person in charge of protection against radiation and environmental pollution at the institute said that owing to the

strict precautionary measures taken there, researchers receive only the smallest radiation dosage, which will not affect their health.

The scientific workers in the institute, about 2,000 in all, have finished 4,500 research projects and developed wide contacts with foreign countries.

Special Report on New Materials R&D in 863 Plan

Introduction, Overview

90FE0265A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jun 90 p 2

[Article by Zeng Hanmin [2582 3352 3046], Scientific Chairman, Materials Area Expert Committee: "New Materials Are the Physical Basis and Precursors of Scientific and Technological Progress"]

[Text] Human history demonstrates that materials are the physical basis and precursors of technological progress. The development of modern high technology is even more highly dependent on the development of new materials. For example, it was only in the early 1970's, when the optical losses of quartz fiber materials were lowered to 20 dB/km and laser materials capable of continuous operation at room temperature appeared that optical communications technology could come into being and develop rapidly, eventually becoming an industry. Progress in developing super-high-purity glass optical fibers, semiconductor materials only a few molecular layers thick, and other new types of optoelectronic materials will bring about a revolution everywhere in information technology; the optoelectronic technology that develops on the basis of these materials will typify the emerging industries of the 21st century. That new materials are the basis and the precursors of all high-technology development is becoming increasingly evident, and new materials have become an important component of present-day high technology.

The main task of the high-technology new materials area is to provide the country's relevant high-technology concerns with key new materials, heat-resistant, erosion-resistant, tough composite materials for power installations, corrosion-resistant, light structural materials for use in astronautics, and special functional materials. While satisfying the needs of the relevant areas by means of this research, new-materials development must explore modern materials science and technology, guided by microstructure theories at various levels, that combines materials design, development, and applications, in order to guide the development of new materials research.

In order to accomplish the above strategic tasks, the new-materials area must complete the following tasks by the end of the century: 1) providing key new materials for the information, astronautics, energy and similar areas in order to assure that their main objectives are smoothly accomplished; 2) explore modern materials science and technology, guided by various microstructure theories, that combines materials design, development, and applications processes in order to guide the development of new materials, and strive to raise the level of the design and preparation of new materials based on predetermined properties; 3) maintain and develop certain of China's advantages in new technology

research, such as maintaining China's definite world leadership position in manmade crystals; 4) establish high-technology new materials research and testing bases and centers that will lay a good foundation for China's sustained development in the new-materials field and will perform a mainstay and stimulating role; 5) continuously convert the intermediate results of new-technology research into applications, promote the formation of the relevant industries, and support national development; 6) develop and train an advanced technological contingent to engage in new-materials research, development and management and to serve as a mainstay of China's high-technology new materials research and development.

The research plan in the new-technology area primarily embodies the spirit of "focus on the leading edge, track actively," and "limited objectives, breakthroughs at key points." The main title of the field is "Key New Materials and Modern Materials Science and Technology." Key new materials with a support function provide support chiefly to such high-technology fields as information, astronautics and energy. Specialized topics in these fields account for about two-thirds of the total in the area and fall into two major subdivisions: functional materials (centered on optoelectronic information materials), and high-performance structural materials (centered on advanced composites). The specialized topics in modern materials science and technology account for about one-third of the total and chiefly comprise new materials design, special preparation, special working, surface alteration, testing and evaluation, and data bases. Research topics and special topics are selected on the basis of five main principles: 1) that they perform key support functions for the relevant fields; 2) that they track the leading edge of development in materials science and technology; 3) that they start from the existing base and make use of domestic advantages; 4) that they both provide for near-term benefits and lay emphasis on an industry orientation; 5) that they have connections with aspects of other state plans.

In the 3 years since the inception of the new-technology area research plan, it has made excellent progress. Late-1989 and early-1990 surveys and evaluations of all research topics and special topics in the area indicate that 68 percent have been accomplished well and 28 percent have been accomplished [satisfactorily], making a combined total of 96 percent. The year 1990 is the last year for comprehensive accomplishment of the intermediate Seventh 5-Year Plan objectives listed among the tasks for this area; the tasks are arduous but the prospects are good. The main advances made in the new-materials area research plan fall into the following six categories: 1) Maintaining international leadership and making new breakthroughs. For example, new crystal varieties such as lithium triborate were developed, and more recently, the Chinese-invented BBO and LBO crystals won 1990 industrial achievement awards at the International Select Laser Exhibition. 2) Filling in domestic gaps and making good beginnings. An example

is the development of high-purity superfine continuous silica glass fibers. 3) Making noteworthy progress and narrowing the gap with other countries. An example is the use of the thermolytic CVD [chemical vapor deposition] method to prepare uniform polycrystalline diamond thin films, already achieving diameters of 30 to 50 mm, which has markedly narrowed the gap between China and other countries. 4) Domestic production of key starting materials, solving the problem of "making bricks without straw." For example: certain reinforcing additives used for research on advanced composites are now gradually becoming available from domestic suppliers; and organometallic compounds and substrate materials that are critical to the preparation of optoelectronic information materials have begun to be supplied domestically in small batches. 5) Certain intermediate research results have already begun to be transferred to economic-development applications. As an example, metal-based and ceramic-based composite materials have already been tested in diesel-engine pistons and metal-cutting tools. 6) Certain centers and bases in the area have already begun to take shape, laying down a good foundation for the Eighth and Ninth 5-Year Plans. An example is the establishment of the State Joint Manmade Crystal Research and Development Center.

Diamond Thin-Film Technology

90FE0265B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jun 90 p 2

[Article by the Diamond Thin Film Topic Group: "Applications of Diamond Thin Films in High Technology"]

[Text] Diamonds are unique among the materials that nature has bestowed on mankind. They are the hardest of all materials, and in addition they have several extremely important and uncommon properties. They are good heat conductors, with a room-temperature thermal conductivity five times that of copper, but in addition they are good electrical insulators, with resistivities as high as 10^{13} ohm-cm. They have excellent optical transmissivity in a broad spectral interval from the ultraviolet to the far infrared. They can be doped to produce semiconductors with a forbidden bandwidth as great as 5.45 electron-volts, and their electron and hole mobilities are respectively 2200 and 1600 $\text{cm}^2/\text{V}\cdot\text{sec}$; coupled with an extremely high breakdown voltage, this makes them suitable for electronic devices designed for use at high temperatures (up to 700°C), high frequencies, and high powers. Diamonds also have excellent chemical stability, very high strength and elasticity, and the highest acoustic wave propagation speeds. This combination of extremely superior properties makes diamonds unique among natural and manmade materials.

But it is only since the early 1980's, with breakthroughs in low-pressure vapor-phase growth of diamond thin films, that diamonds' various superior properties have become usable in many high-technology areas. Diamond thin films can be used for superhard coatings on tools,

windows of various types (laser windows, particle-beam weapon windows, X-ray windows), optical components and coatings, acoustic devices, heat sinks for microelectronic and optoelectronic devices, and even more attractive high-temperature, high-frequency, high-power, radiation-resistant semiconductor devices. As a result, a "diamond thin-film fever" has swept around the world in recent years, and such countries as the United States, Japan and the Soviet Union have invested immense manpower and material resources in an extremely intense competition. Diamond thin films are now entering the practical application stage, and it is estimated that in the next 10 to 15 years they may constitute a US\$10 billion market.

It was in the context of this intense competition that the 863-Plan new materials area decided to engage in "research on the preparation and applications of diamond thin films." In the course of 3 years, thanks to the energetic efforts of a large body of research personnel and to the vigorous guidance of the expert group, noteworthy progress has been made.

Before the implementation of this topic, only a few units in the country were investigating the vapor-phase growth of diamond thin films, and only one process, the "hot-wire CVD method," was in use; in addition, the deposited material did not coalesce into patches and did not form a film. As a result of more than 2 years' effort, at the end of 1989 all of the major units working on this topic were able to produce continuous, uniform, high-quality diamond films 25 mm (1 inch) in diameter. The greatest size now achieved is 50 x 50 mm (2 inches square). From the original exclusive use of the hot-wire CVD process, research has now gone on to a variety of other processes, such as microwave plasma CVD, direct-current plasma jet CVD, and electronically assisted ion-beam deposition. A method of in-situ analysis of diamond thin films during the CVD growth process based on optical emission spectroscopy (OES) has been developed. The first steps have been taken in implementing large-area, uniform, high-speed deposition of diamond thin films; under the leadership of the expert group, preliminary applications research related to uses in microelectronics, optoelectronics, X-ray windows, and high-temperature semiconductor devices is being pursued.

Even more importantly, as a result of the implementation of the 863 Plan, a fledgling diamond thin-film research contingent has begun to take shape. We may predict that this contingent will gradually narrow the gap between Chinese attainments and the world state-of-the-art and will make an extremely important contribution to the application of diamond thin films in the national economy.

Photo caption: An experimental apparatus for boron fiber deposition in operation [photo not reproduced]

Ion Implantation Technology

90FE0265C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jun 90 p 2

[Article: "Major Progress in Ion Implantation Technology"]

[Text] Ion implantation technology is an effective means of improving the surface properties of structural materials. Implantation of certain metal ions into metal surfaces can greatly increase their surface hardness, wear resistance and corrosion resistance. Ion implantation treatment of ceramics and polymers can even produce certain new functions.

Since the implementation of the 863 Plan, China's scientific and technological personnel have engaged in 2 years' vigorous effort in order to promote the development of modern materials science and technology, achieving preliminary successes in developing a key component of a new-generation ion implantation device at the world state-of-the-art, namely, the MEVVA (metal evaporation vacuum arc) source. At present, only a few countries, such as the United States and Japan, are developing such sources. In the United States, the original intention was to use it in heavy-ion accelerators, and research reports began to appear in 1985. Its use in ion implantation technology began to be investigated in 1986. China began tracking this technology in early 1987; it had its first development successes in late 1989 and is further pursuing applied and basic research on ion implantation applications.

Ordinary ion implantation equipment is capable of implanting only a few types of ions, such as nitrogen and oxygen, and the maximum attainable beam current is only a few milliamperes. But the average current of the MEVVA source may reach several tens of milliamperes or even 1 ampere. MEVVA sources developed in the United States have reached 20 mA, and the next stage of research will reach 60 mA. The high current greatly shortens the time required for ion implantation. Of particular importance, it can eject all metal ions from lithium (Li) to uranium (U), other than a few liquid metals; this greatly expands the range of the ion implantation technique, making it possible to prepare many surface films that would be all but impossible to produce with ordinary ion implantation.

The MEVVA source whose successful development has been begun in China can eject various ions such as C, Al, Ti, Cu, Fe, Mo and W; actually, the number of ions that can be ejected is much greater. The average current of the ejected ions can reach 10 mA, with continuous arc operation for up to 12 hours. Implantation of Ti ions into H13 steel decreased wear by a factor of 5. Implantation of both Ti and C ions into H13 steel decreased its wear coefficient from 0.7 to 0.2. Ion-implantation treatment of a die for pressure bonding of aluminum shaped sections decreased the force required by 10 percent. The performance characteristics of the ion source have now

been further improved and its power utilization efficiency has been increased; an effort is being made to complete the experimental development of the first test model of a MEVVA ion-implantation unit by the end of the year.

The design of the equipment is to be finalized during the Eighth 5-Year Plan, and a series-produced product will be developed and its practical use disseminated among the mechanical engineering departments. In addition, basic research will be stepped up in order to make a more thorough study of the film-formation mechanism and the patterns of change in the organizational structure of materials in order to develop new functions. We may expect that the successful development of the MEVVA source and the new ion-implantation technology will bring major economic benefits to the mechanical engineering industry.

High-Performance Resin Composites

90FE0265D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jun 90 p 2

[Article: "High-Performance Resin Composites Research Makes Headway"]

[Text] The research objective in high-performance resin-based composite technology is to track the international leading edge, to develop high relative-strength, high relative-modulus structural materials for use at temperatures between 150° and 350°C, and to support relevant high-technology fields such as astronautics, aeronautics, and energy. High-performance resin-based composites are a key item in the new-technology field. In the 2-plus years that this special topic has been in existence, there has been considerable progress in base resins, composite technology, interface technology, and molecular self-reinforcement.

The thermosetting polyimide resins that China has developed have properties generally equivalent to those of the corresponding U.S. products. Carbon-fiber-reinforced panels made from these resins can be used at temperatures of up to 300°C, and they are therefore among the small number of resins worldwide that are universally recognized as being able to withstand such high temperatures under load.

The thermoplastic polyimide resins that China has developed have a distinctive structure and a distinctive method of synthesis, and their mechanical properties and heat resistance are essentially equivalent to those of foreign high-performance high-temperature resins. They can be used at temperatures of up to 200°C. Progress in research on these resins has provided superior candidate materials for the development of advanced engineering plastics.

In addition, the new materials area has also set up research on heat-induced liquid-crystal molecular self-reinforcement of all-aromatic polyester and polyalkene polymer materials. For example, the material resulting

from molecular self-reinforcement of Chinese-produced high-density polyethylene has a strength of up to 150 MPa [megapascals], five times that of ordinary polyethylene. The heat-induced liquid-crystal macromolecules are attractive for both domestic and worldwide use in advanced high-relative-strength, high-relative-modulus, high-temperature resin materials.

New Functional Materials

90FE0265E Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jun 90 p 2

[Article by Functional Materials Expert Group: "Progress in New Functional Materials"]

[Text] The reason that the main trend in the development of modern materials is led by new functional materials is the demands of the information, space, energy, and computer fields regarding the optical, electronic, acoustic, magnetic and other physical properties of materials. China's objectives in the development of high-technology functional materials are: to provide key new materials for the above fields of technology; to develop a modern materials science and technology, under the guidance of various types of microstructure theories, that combines materials design, research and applications, and to raise China's functional-materials development standards; to consolidate and develop China's distinctive characteristics; to train a large contingent of personnel for new functional materials research and development and management; and to lay a good foundation for the development of functional materials and the relevant high technologies in China during the next century.

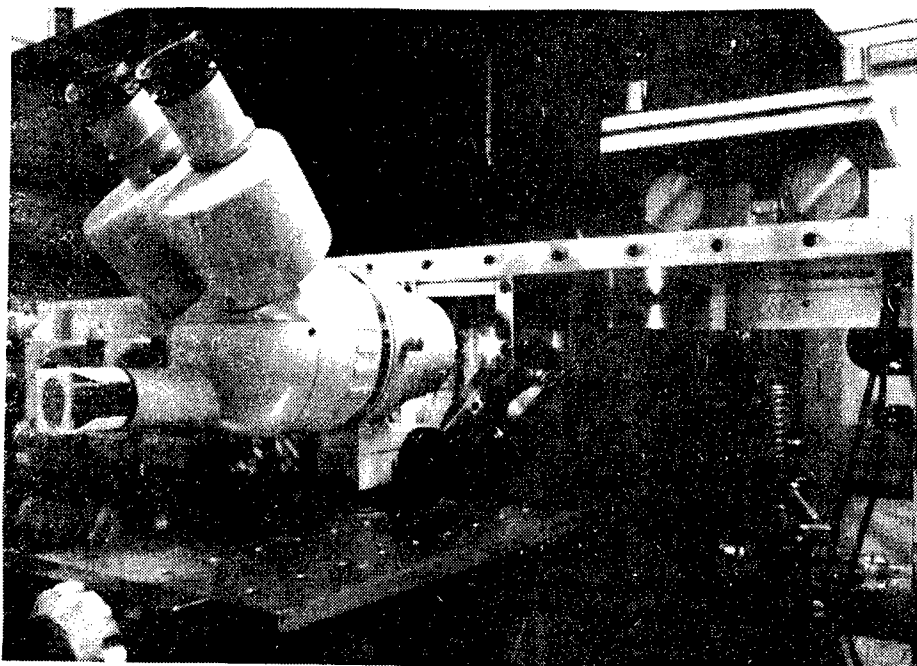
It is universally recognized that the 21st century will usher in the information age. The relevant optoelectronic information materials will be of major importance in the acquisition, transmission, storage, display and processing of information and in computation. As a result, optoelectronic information materials are among the key materials in high-technology functional materials research. Under the 863 Plan, particular emphasis has been placed on setting up research topics or special topics dealing with new types of semiconductors and optical fibers, special-property thin films (including diamond thin films), special ceramic films and LB [Langmuir-Blodgett] thin films, new nonlinear optical crystals and laser crystals, new optical storage and display materials, fine ceramics, fine composite optoelectronic functional materials, and new organic optoelectronic materials.

As a result of the focused arrangements made under the 863 Plan, proceeding from the existing base, the research on optoelectronic information materials has already achieved major progress. For example, Chinese research on artificial crystals has obtained a group of research successes that are at the world state-of-the-art, including the growth of such striking new Chinese-brand crystal

varieties as lithium triborate, magnesium-titanium-doped lithium niobate, fixed-temperature ultraviolet frequency-doubling crystals and the like, and has had noteworthy success with five or six types of crystals, such as iron-doped lithium niobate, iron-doped barium titanate and the like. Basic research on the testing, behavior, and applications of manmade crystal materials has intensified, and China's population advantage in manmade crystals has been developed. Close to ten advanced thin-film and fiber material preparation technologies that have only recently appeared abroad were mastered and developed, such as unique equipment for laser-heated pedestal growth (LHPG) of crystalline fibers and the drawing of functional crystal fibers and superconductor fibers, advancing China to the world forefront. China has independently produced multiple-ion-beam reactive co-sputtering technology that is keeping pace with foreign developments and has developed the corresponding equipment, which has already been used to produce highly oriented ceramic films and will play a role in various series of ceramic film investigations. Several key starting materials have been developed, and important progress has been made with various advanced optoelectronic device materials. It is hoped that three MO source materials will begin to be produced domestically by the end of the Seventh 5-Year Plan, that GaSb and InAs substrate wafers will be in production in large lots, that diamond thin films, special ceramic thin films, and LB thin films will be made available for experimentation and that there will also be marked progress with photon hole-burning and other optical storage devices and with long-wave (2-4 micron) optoelectronic probe materials.

As a result of the implementation of the 863 Plan, modern materials science and technology related to new functional materials, combining materials design, research, and applications processes under the guidance of various microscopic-structure theories, has made good technological progress; manmade crystal design and growth technology have stayed at the international leading edge in certain respects; materials-design expert systems, the microstructure design and prediction of the properties of semiconductor alloys and superlattice materials, and nanometer composites design have a distinctively Chinese flavor, and the technologies for preparing several types of thin films and fiber materials have greatly narrowed the gap with the world state-of-the-art.

There have also been various degrees of progress in connection with other functional materials. Certain projects will result in the development of prototype machines, product samples or small trial-production lots during the Seventh 5-Year Plan, thus laying a good foundation for the beginning of intermediate testing during the Eighth 5-Year Plan. Examples include high-performance multilayered low-temperature-sintered ceramic capacitors, hydrogen-nickel batteries, all-solid-state lithium batteries, hydride heat-pump air conditioners, and hydrogen compressors.



The Open Laboratory at Qinghua University for the Chinese-Built Model HSH Laser Pedestal Device, Used for Growing Functional Optical Fibers, Which Is at the World Forefront

High-Performance Structural Materials

90FE0265F Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jun 90 p 2

[Article by Structural Materials Expert Group: "Track the World State-of-the-Art, Develop High-Performance Structural Materials"]

[Text] High-performance structural materials will be of major importance in many engineering departments, such as aeronautics and astronautics, development of the seas, communications and transport, energy, chemical engineering, and mechanical engineering. The task of high-technology structural materials research in China's high-technology research plan is to provide such relevant fields as astronautics with key new high-relative-strength, high-relative-modulus, heat-resistant, tough, corrosion-resistant, wear-resistant supporting-role materials, to promote the development of modern materials science and technology, and, while strengthening basic research, to vigorously pursue applied research and accelerate the application of intermediate research results.

The changeover to structural composites is a main trend in the development of high-performance structural materials. Advanced composites have already become a major component of materials, because they have superior combined properties that single materials lack. As a result, we have made research on high-performance composites the focus of work on structural materials and

have made priority arrangements for the supply of the principal reinforcing additives and high-performance resins that are essential to advanced composites. High-performance ceramics are a matter of extreme interest to all countries and are one of the most rapidly developing fields of research. The 863 Plan has pursued research on such important materials systems as silicon carbide and silicon nitride, geared to the use of high-performance ceramics by the astronautics, aeronautics, and power departments. High-performance metallic structural materials centered on ordered intermetallic compounds of the Ni-Al and Ti-Al series and high-solidification-rate light alloys are major components of high-performance structural materials. In addition, research on special materials with a clear supporting function such as heat-protection system materials for aerospace and channel materials for coal-fired magnetohydrodynamic (MHD) electric power generation has also been initiated.

Materials science and technology will engage in intense competition centered on new technologies, new processes, and new testing methods: this is a breakthrough point in the development of new materials. The main subject matter of China's high-technology new-materials research plan now includes: special preparation technologies for new materials, focusing on supermicroscopic particle preparation and microwave sintering of ceramic materials; special technologies for working new materials, centered on hydrostatic-pressure forming of hard-to-deform materials, superplastic forming of such new materials as ceramics and intermetallic compounds,

shock-wave forming of noncrystalline or microcrystalline materials, and bonding of dissimilar materials; materials testing and evaluation technologies focused on few-dimension materials testing and evaluation, ultrasonic nondestructive testing of fine ceramics, and online analysis of energy-band engineering materials; surface alteration technologies centered on ion-beam reinforcement deposition, high-current heavy-metal ion implantation, laser surface alloying and laser chemical vapor deposition; and new composites technologies in which metallic and nonmetallic materials are combined at various structural levels.

The Seventh 5-Year Plan is the initial stage of new materials research under the 863 Plan, and despite the limited time available for research, the progress achieved has been encouraging. Experimental production lines or units for producing five major types of high-performance reinforcing materials with small-batch trial production capabilities and with performance close to that of corresponding foreign models have been tentatively completed. It is expected that during the Eighth 5-Year Plan, they will provide domestically produced fibers and whiskers for experimental research on advanced composites. The laboratory properties of several major heat-resistant thermosetting resins and thermoplastic resins for use as base materials are equal or nearly equal to those of their foreign counterparts. These advances have set the stage for future research on advanced composites. Laboratory research on such important materials systems as metal-based composites, including aluminum reinforced with silicon-carbide fibers, whiskers and particles, and aluminum reinforced with boron fibers; silicon-nitride ceramic-based composites further strengthened with silicon-carbide whiskers; glass ceramics further strengthened with silicon-carbide fibers; silicon-nitride high-temperature structural ceramics; high-solidification-rate aluminum-lithium alloys; and Ni-Al system and Ti-Al system ordered intermetallic compounds is equivalent to the international level of research in the mid-1980's. Real-world applications results have been obtained with some of the materials. In addition, research on astronautic heat-protection systems has made great strides. A channel material for coal-fired MHD generators has already passed a 200-hour dynamic operating test.

In new technology and new process research, initial success has been achieved in developing an improved metal evaporation vacuum arc (MEVVA) source for use in surface alteration of materials by ion implantation, capable of achieving a current of 10 mA, and of ejecting most metal ions. The first experimental model of the device will be trial-produced at the end of the year, and a practical design should be developed and put into series production during the Eighth 5-Year Plan. The development of the device will provide a new and important means of surface alteration for producing wear-resistant machine parts. In addition, reinforcement by ion-beam deposition is being used to prepare high-quality composite ceramic coatings on metal surfaces; a fine-ceramic microwave fast-sintering device with an

output power of 5 kW, capable of producing a temperature of 2000°C, is being developed; a superplastic aluminum-lithium alloy plate material for a relative elongation of more than 800 percent is being developed; and a variety of brazing materials for use at 600°C are being developed.

It is evident from the research projects described above that as a result of the research during the Seventh 5-Year Plan, there are prospects that initial success will be achieved in providing a supply of the major source materials for experimental research on high-performance composite materials, that laboratory research on the principal materials systems for high-performance structural materials has reached the international mid-1980's level, that research on certain new technologies has already made major progress, and that some new materials are already revealing prospects for development and applications.

China's First Pulsed Reactor Passes Safety Checks

90P60052 *Beijing GUANGMING RIBAO in Chinese*
22 Jun 90 p 1

[Text] (XINHUA)—Chengdu—21 Jun—China's first pulsed reactor has just passed its safety checks in Sichuan. The Chinese designed and built pulsed reactor is a facility used for the production of isotopes, neutron photography, nuclear physics research, and radiation experiments. There are only a few such facilities in the world.

1989 Achievements, Future Development in Metallurgical Science, Technology

90FE0112A *Beijing GANGTIE [IRON AND STEEL]*
in Chinese Mar 90 pp 1-4, 8

[Article by Tao Jin [7118 2516], Ministry of the Metallurgical Industry: "1989 Achievements and Future Developments in Metallurgical Science and Technology"]

[Text] In 1989, implementing the general policies of "reform and opening to the outside" and "imposition of order and rectification," China's metallurgical industry overcame a variety of difficulties in energy and transport and victoriously completed its iron and steel production plan. Steel output for the first time broke through the 60-billion-ton mark, and the outputs of such major products as pig iron, steel materials, iron ore and coke were above the 1988 levels. There was an improvement in product quality and a rather large increase in the assortment of steel products. Scientific and technological activity focused on economic construction and achieved numerous results. Eleven state science and technology progress awards, eight invention awards, two gold medals for patented inventions, and 170 ministry science and technology progress awards were won in 1989; the new-technology development and innovation effort on the Wugang Iron and Steel Works 1.7-meter rolling

mill was rated by KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] as one of the ten top science and technology achievements in China during 1989; and 100 key scientific research results that the Ministry of Metallurgical Industry (MMI) disseminated produced an annual economic benefit of more than 500 million yuan. A group of enterprises implemented the science and technology contracting and management contracting responsibility system. The economic benefit realized from scientific and technological progress at such enterprises as the Angang and Fugang Iron and Steel Works accounted for more than 40 percent of the net annual increase in economic benefits. Some enterprises have changed over to a reliance on scientific and technological progress and on raising the level of industrial technology and management standards.

1. Main Results in Metallurgical Science and Technology for 1989

1.1. Ironmaking and Sintering

Energy consumption by the ironmaking system accounts for more than 65 percent of total energy consumption by the metallurgical industry, and energy and transport shortages chiefly affect ironmaking. At one point early in the year, daily iron output fell to about 140,000 tons. In order to reverse the passive production situation, vigorous efforts were made to disseminate such blast-furnace technologies as injection of coal dust, the oxygen-enriched air blast, use of small-piece coke, ore-and-coke mixture charging, blast furnace water conservation, excess-pressure electric power generation, and hot blast stove waste heat recycling; in the sintering field, low-temperature sintering, improved igniters and an improved sintering process were disseminated; and the renovation of blast furnace powered-coal injection equipment was stepped up. There was a rather large increase in the scale of powdered-coal injection at such enterprises as the Baogang Steel Works, and the No 4 blast furnace at the Shougang Steel Works reached an injection rate of 148 kg/ton with an oxygen enrichment of 3.6 percent, achieving a good annual utilization factor of 2.584. Such enterprises as Wugang and Angang used small coke pieces 8 to 25 mm in diameter for mixed furnace charging, increasing their output by 1.6-3.9 percent, and Wugang saved about 15.5 million yuan in the course of the year. In the blast furnaces at Taigang, a dry method of removing dust from furnace gases has passed its evaluation and has been put into trial operation, and a domestically produced 4500-kW blast furnace bell excess-pressure power generating system has been built and commissioned, generating more than 1 million kW per month. A double-alkalinity double-pelletizing sintering process has passed industrial tests; it will decrease the energy consumption per ton of sintered ore by 28.46 kg and increase output by 28.1 percent. This research result will be used in the renovation of the sintering plant at Angang.

In 1989, four 1200-cubic-meter blast furnaces and one 2-million-ton-per-year belt-type pelletizer unit went into

operation around the country, and blast furnace equipment reached the world level of the late 1970's. The blast furnace, sintering plant and coking plant facilities of stage 2 at Baogang included 87 percent domestically produced equipment.

Rotary-furnace direct reduction technology made major breakthroughs. Continuous experimentation and production was carried on in 40-meter furnaces, with the metal conversion rate exceeding 94 percent, dry coal consumption of 890 kg/ton, and sulfur and phosphorus levels below 0.015 percent; operation was normal, with no crusting or the like. In the third intermediate test of the new Panzhihua vanadium-titanium recovery were significantly better than in the previous two tests. Based on the test results, a program for the construction of a 100,000-ton-per-year experimental high-quality steel plant has been proposed.

1.2. Steelmaking

In order to deal with the shortage of electric power and iron alloys, the product mix was adjusted, the output from rotary furnaces was increased to about 60 percent of total output, and the expansion of electric-furnace ironmaking was slowed. Such alloy oxides as vanadium slag, granulated scheelite, chromium ore, and calcium molybdate were used for direct alloying of molten steel; more than 300,000 tons of low-alloy steel and alloy steel varieties have been produced by these methods. The use of molybdenum slag as a replacement for ferromolybdenum alone decreased production costs by more than 30 yuan per ton. Some steel works use wire-feed machines to feed core wire, which has approximately doubled the rate of recovery of such elements as aluminum, vanadium, titanium, boron, calcium, and rare earths. The output of rare-earth-treated steel exceeded 250,000 tons, and there was a very rapid development of titanium-microalloyed steel. The properties of these microalloyed steels were greatly improved. Materials such as graphitoids were used in electric-furnace steelmaking as a replacement for carbon enrichment of pig iron, yielding a saving of about 200 yuan per ton of graphitoid; this technology is being extended to open hearth furnaces and rotary furnaces.

There have been new developments in combined-blast refining in rotary furnaces: double-channel oxygen lances are now being used in production, increasing rotary furnace thermal efficiency by 8 to 10 percent, making it possible to compensate the refining temperature by 15-30 degrees celsius and decreasing the amount of iron oxides in the slag to 2-3 percent. Intensified bottom-blowing of oxygen has produced preliminary results, with refining of such new varieties as stainless steel and severe-climate steel. Test results with high-pressure bottom blowing have been good, with pronounced suppression of splashing and an increase in the iron alloy recovery rate. The output of combined-blast steel increased by 11.8 percent compared with 1988.

1.3. Continuous Casting

The 1989 output of continuous-cast blanks exceeded 10 million tons, and the continuous casting ratio was increased to 16.38 percent, compared with 14.7 percent in 1988. Seventeen continuous casting machines were built in 1989, with a rated capacity of about 7.5 million tons, the largest annual increase in production capacity to date. After continuous casting of alloy steel blooms and slabs was begun, the casting of more than ten varieties, including stainless steel, spring steel and alloy structural steel, was tested. The horizontal continuous casting machines that have been put into production can produce 5-mm to 180-mm cast blanks. The Chengdu Seamless Steel Pipe Plant's horizontal continuous casting machine has become a major production unit at that plant. There has already been good progress in the development of thin plate continuous casting. Continuous slab casting machines have already equaled or surpassed their rated capacity; but on average, only 50 percent of continuous billet casting machines reach their rated capacity. The situation with imported tandem continuous casting equipment is not good. Further conscientious summarization of experience and lessons, combined with vigorous measures, are needed.

1.4. Rolled Steel and Steel Products Assortment

1989 Key Efforts in Steel Rolling

First, efforts were made to decrease average energy consumption in soaking pits and heat-treatment furnaces, and steel ingot hot-packing and hot transport technology was vigorously disseminated. The hot-packing temperature in the key enterprises has already been raised about 800°C. Enterprises such as Angang adopted the red-heat transport micro-energy heat treatment technology for steel ingots and implemented low-oxidation-soaking uniform-heat hot rolling, which markedly decreased energy consumption for heating, and at the same time improved the surface quality and acceptance rate of the ingots. The great majority of enterprises have accelerated the rate of technical modernization of furnaces and have made extensive use of insulated furnace walls, have decreased the use of water-cooling pipes, and have used waste-heat recirculation, microoxidation burning control, and improved heating processes, achieving a pronounced increase in the thermal efficiency of heating furnaces.

Second, energetic efforts were made to adjust the product mix and to increase the output of products in short supply such as plate and pipe. In 1989, in combination with a steady increase in the exploitation of unused potential at plate and pipe works, the construction of new plants and the modernization of old plants was stepped up. The Baogang 2050-mm hot and cold continuous rolling machine and the Angang 1700-mm four-stand continuous rolling machine are already being used for trial production. Of the existing 21 medium plate rolling units, 13 have been modernized in the last few years, with a marked improvement in product

quality and a large increase in output. The Bengang continuous hot rolling unit, which was modernized the year before last, had an output of more than 1.5 million tons in 1989, exceeding its rated capacity. After the Angang 100-mm seamless rolling unit was modernized, it went into production smoothly. A high-precision four-roll cold rolling machine has been built at Shanghai and is producing 0.1 x 250 mm strip, with a thickness deviation as small as 3 microns. It is predicted that in the next few years the output of plate and pipe will rise markedly and that the market shortages of these products will be somewhat alleviated.

In the area of profile steel, Pangang is constructing a heavy-rail quenching line with an annual capacity of 50,000 tons. The relative life of its steel rail, produced by variable-speed full-length quenching, is 1.5 times that of ordinary steel rail. Magang is currently constructing an H-shape rolling mill, which is expected to go into operation in 1990. The pace of modernization of medium and small-size rolling mills is being stepped up and more than 100 short stress line, high-rigidity rolling machines have already been set up. The dimensional variation of small profiles has been decreased sufficiently to reach the high-accuracy class.

In the area of wire rod materials, in addition to the 10 high-speed wire rod rolling mills that have already been imported, five domestically designed and built high-speed wire rod rolling mills have gone into production, with test production from high-carbon steel, spring steel, stainless steel and various types of special-purpose wire rod, with a dimensional variation of as little as 0.20 mm. Industry policy is that no further old-style double-duo wire rod mills will be built.

In the past year, more than 1000 new products have been developed, including 600-MPa [megapascal]-class high-strength steel for engineering machinery, automotive and tractor steel, silicon steel for 300,000 kW generators, microalloy high-strength steel for use in mining, low-tin steel plate plated with 1.5-2.0 grams of tin per square meter, steel pipe coated on both sides, cold-rolled knurled steel reinforcing bars and the like. The first specialized horizontal sphenoidal rolling mill has been completed and has begun operation, producing 10-odd varieties of nonstandard axles for motor vehicles, tractors and electrical machinery.

There has been good progress in using the reductive diffusion method to produce neodymium-iron-boron alloy, and the production cost is likely to be 30 percent below that of the original process. High-performance Nd-Fe-B permanent-magnet alloy has a magnetic energy product of 49.5 megagauss-oersteds, on a par with the world state-of-the-art. The first 100-ton automatic non-crystalline coiling unit has passed its technical evaluation. Carbon-fiber research has also made considerable progress.

1.5. Mines

The development of sets of equipment for 10-million-ton large opencut mines won a special state scientific and technological progress prize. The equipment, whose primary component is a 108-ton electric-wheel truck, is already being supplied in lots to domestic mines, and small numbers are being exported. The domestic-production percentage of the 154-ton electric-wheel truck has been increased to more than 60 percent.

After testing at the Bengang Steel Works's Nanfang Mine, the steep-terrain mining technology decreased stripping by 5 million tons, producing an economic benefit of 15 million yuan.

Tests of large mine explosions have yielded preliminary success, with a single blast energy of up to 500-700 kilotons; these successes in technology research will pave the way for the development of large mines in China.

In order to further raise the recovery rate and grade of ore concentrates, the Baogang and Angang steelworks' Qidashan concentrate plant is undertaking beneficiation technology improvements based on a new process flow-chart. Renovation of the Pangang titanium ore concentrate plant should approximately double its output. In 1989 the assay of the concentrate reached 60.39 percent, up 1.02 percent from 1988, which was the fastest rate of increase in the last 5 years.

Although there was considerable research on mine extraction and beneficiation, owing to the low grade of the ore and the complexity of its composition and to a low construction investment intensity, the lack of self-sufficiency in ore will continue for several years.

1.6. Automation

In blast furnaces that have newly been put into production, the "three-electronic" system was entirely domestically designed, the software was domestically developed, and most of the instrumentation was independently domestically produced; experience indicates that this technology is mature and has reached the foreign late-1970's level.

In rotary furnaces, secondary lance head production has been mastered domestically, and the error of temperature and carbon determinations is entirely in accordance with the Baogang technical requirements.

In the area of rolling mills, the electrical instrumentation systems of high-speed wire-rod rolling mills can now be domestically produced, and the main electrical system for the transport facilities at the Angang 4-stand cold rolling unit, with a total power of 25,000 kW, was entirely designed, built, tested and adjusted by the Institute of Automation. There has been new progress in the use of computers in the metallurgical industry: 7,000 microcomputers are installed in the system, and after medium and small-size enterprises such as Lianyuan introduced microcomputers for management purposes, their management performance improved.

1.7. Ferroalloys and Refractory Materials

The output of ferroalloys was up slightly from 1988. The first 1800-kVA [kilovolt-ampere] direct-current electric furnace went into operation; its electrode consumption was half the previous level and its electrical consumption was 5 percent lower. There have been breakthroughs in powdered chromium ore briquetting technology.

Development of refractory materials has made considerable progress. The average lifetime in rotary furnaces at such large enterprises as Angang, Wugang, Taigang, Baogang and Shougang exceeds 1000 heats, and the maximum lifetime among the Angang 180-ton rotary furnaces has been 2038 heats.

Domestically produced silicon carbide brick has been used at five blast furnaces around the country. Four years ago, silicon carbide brick was installed in the No. 5 blast furnace at Angang; tests indicate that about 150 mm still remains, a result that lays an excellent foundation for prolonging blast furnace life. A decision has been made to disseminate this technology.

The self-sufficiency rate of refractory materials for use at the Baogang Steel works has been raised from about 20 percent in 1985 to over 90 percent, and vigorous efforts are being made to achieve complete self-sufficiency in a short time. But the quality of some refractory material still does not meet requirements for the development of steelmaking and is adversely affecting product quality and increasing specific consumption; this is one of the chief current problems.

1.8. Modernized Management

After introducing the 18 state-sponsored modern management techniques, MMI expanded them to 30 techniques. It gradually has developed distinctive, differentiated models. For example, the Shougang management model based on contracting, guarantees an annual increase of 20 percent in economic benefits. The Wugang model, which is centered on comprehensive quality control, earned its product quality and after-sale service a rating of first in the industry from the users' committee of the China Quality Control Society. Angang's "one body, two wings" contracting experience has resulted in management benefits and technology-development benefits of more than 400 million yuan. The new, modern, large-scale production management model developed at Baogang has brought output to rather high levels.

Although science and technology activities in 1989 posted many achievements, they were adversely affected by numerous factors, and energy consumption per ton of steel output essentially remained at the 1988 level. The overall coke ratio of blast furnaces at the key enterprises reached 567 kg/ton, up 11 kg/ton from 1988. Electric furnace power consumption increased by 9 kW/ton. Some enterprises has a slight increase in iron and steel materials consumption and a slight decline in the quality acceptance rate. Coking coal ash content was 14.36 percent in the first 10 months of 1989, up 0.56 percent

from 1988, which adversely affected blast furnace output. The sulfur content of iron and the time required for steel refining increased slightly at a small number of enterprises; these matters merit close attention.

2. 1990 Areas for Major Effort in Science and Technology

In 1990 we must conscientiously implement the spirit of the Fifth Plenum of the 13th Central Committee. We must unswervingly implement the guidelines of imposing order and rectification and of making reform more thorough, do effective work in science and technology, and strive to make the iron and steel industry develop continuously, stably, and in coordinated fashion.

2.1. Strive To Produce and Develop Scarce Varieties Urgently Needed by the Country, Further Improve Product Quality

We must act in accordance with the request made by Minister Qi in his speech at the metallurgy work conference, according top priority to assortment and quality; we must focus on research to provide for the 10-odd varieties of large-scale companion equipment urgently needed by the mechanical engineering industry and the 120 key varieties needed by the national defense industry and the light industry market. In regard to quality, we must disseminate and improve the 10-odd new technologies in coking coal quality, desulfuring of molten iron, in-ladle powder injection, out-of-furnace refining, and controlled rolling. We must complete the 462 production lines with improved produce quality that are called for in the Seventh 5-Year Plan, continuously disseminate the Wugang experience in strengthening quality control, and raise the percentage of steel materials produced in accordance with international advanced standards to more than 40 percent. We must base even more products on domestic supply, decrease imports, and conserve foreign exchange.

2.2. Strive To Conserve Energy and Decrease Consumption

The 1990, iron and steel industry production will still face considerable difficulties. The shortages of raw and other materials, electric power, transport, and funds will not improve soon. As a result, we must further rely on technology, tap unused potential, strengthen management, make efforts to conserve energy and decrease consumption, and strive to bring 1990 energy consumption per ton of steel down to 1.62 tons of standard coal. Comparable energy consumption at the key enterprises must be brought to 1.0 tons of standard coal or less, and some enterprise should reach 0.9 ton of standard coal. We must expand semikilled steel production, improve ingot molds, disseminate hot-cap technology, implement negative-deviation rolling, rationally control cropping, and strive to raise the steel products acceptance rate by 0.5 percent. We must vigorously disseminate the 20-odd

coke-saving, electricity-saving and iron-saving new technologies, including powered coal injection in blast furnaces, the use of graphitoids to increase carbon content, energy-saving heating furnaces, gas recovery in rotary furnaces, excess-pressure electric power generation in blast furnaces, wire feed in pouring from alloy ladles, and energy-saving blowers, so that the energy consumption per unit output is decreased. We must take vigorous measures in regard to the weak links such as mines and refractories, and accelerate their development.

2.3. Take Steps To Accelerate the Commissioning of New Facilities and Their Attainment of Full Capacity

A large number of blast furnaces, continuous casting machines and rolling machines went into production in 1989, and it is planned that in 1990 an additional 3200 cubic meters of blast furnace capacity, and more than 10 continuous casting machines and H shape rolling machines will be completed. Getting these facilities into stable operation as quickly as possible and reaching their rated capacity is a major task of scientific and technical activity. In addition, the output and quality of the "4 plates, 3 pipes and 1 wire," i.e., hot and cold continuous rolling machines, seamless pipe rolling machines and high-speed wire-rod rolling machines, must be greatly increased in 1990.

2.4. Strive To Implement the Key Projects of the Seventh 5-Year Plan and To Draft Scientific and Technological Development Programs for the Eighth 5-Year Plan

1990 is the last year of the Seventh 5-Year Plan and is the key year for the drafting of the Eighth 5-Year Plan. As a consequence, implementation of the five key state scientific and technological projects of the Seventh 5-Year Plan, i.e., rotary furnace compound blast technology, continuous casting of specialty steel, development of mine technology, alloy steel and low-alloy steel, and the Panzhihua-Baotou integrated resource development effort, must be fulfilled on time. We must ascend to a new plateau during the Eighth 5-Year Plan, organize breakthrough efforts, strive to make breakthroughs as rapidly as possible in providing for the urgent needs of the iron and steel industry, including such major topics as oxygen coal ironmaking, thin-plate continuous casting, improved quality of refractories, integrated resource utilization, deep-depression opencut mining technology, and acicular coke.

In addition, we must organize a picked force to perform effective research on the 863 Plan high-technology topics and promote the implementation of the Torch Plan.

2.5. We must strengthen enterprise management, establish and improve the technological development and production technology management system, run by the chief engineer under the guidance of the plant director, establish and strengthen the technology development mechanism, institute enterprise technological progress evaluation indicators, and carry out evaluations strictly.

2.6. We must strengthen international scientific and technological cooperation. While continuing to place the primary emphasis on self-sufficiency, we must vigorously develop international scientific and technological cooperation, and absorb advanced scientific and technological results and experience from all countries, so that China's metallurgical science and technology is raised to a new plateau.

Domestically Developed LBO Crystals Pass Accreditation

90P60057 Shanghai JIEFANG RIBAO in Chinese
13 Jul 90 p 1

[Article by Jia Baoliang [6328 1405 5328]: "LBO Crystals Developed in Shanghai"]

[Summary] At a press conference held yesterday, a spokesman for the Chinese Academy of Sciences' (CAS)

Shanghai Institute of Silicates revealed that—in line with the institute's world-class BBO [beta barium borate] crystal—a new crystal, called LBO [lithium triborate, LiB_3O_5], recently developed by the institute and marketed internationally [by Fujian Castech Crystals, Inc.] has attracted the attention of experts from Japan, the U.S., Britain, and other countries, who have asked China to provide samples. Yesterday, this major new product passed CAS-level technical appraisal in Shanghai.

This new crystal, which has applications in many high-tech areas such as the electronics industry, modern space technology, satellite communications, and mobile communications, is grown by the Chinese-pioneered "crucible drop method" and is available in 3-inch diameter pieces. China has taken a position as the world leader in the industrialization of the technology necessary to produce this LBO crystal.

Expression of Human Interleukin 4 in E. Coli

40091014M Beijing ZHONGHUA
WEISHENGWUXUE HE MIANYIXUE ZAZHI
[CHINESE JOURNAL OF MICROBIOLOGY AND
IMMUNOLOGY] in Chinese Vol 10 No 3, Jun 90
pp 137-140

[English abstract of article by Li Chen [2621 2525],
Zhang Zhiqing [1728 2535 3237], et al., Department of
Immunology, Beijing Medical University]

[Text] By means of gene manipulating techniques, a complete human interleukin 4 (hIL-4) cDNA which has been constructed by the ligation of EcoRV-BamHI fragment from hIL-4 cDNA with synthetic oligonucleotide linker, was inserted to downstream of P_RP_L promoter on the plasmid pBV220. The pBV200 contained temperature sensitive clts857 gene. The constructed hIL-4 plasmid was referred to as pBV220/hIL-4. It was transformed into the E. coli strain DH5 α and the expression of hIL-4 was achieved at 42°C. The M. W. of expressed hIL-4 was about 15 KD as assessed by SDS-PAGE electrophoresis. 2x10⁶ units of hIL-4 were produced from 1 liter of bacterial culture in flask. Gene expressed product was insoluble, which existed in the form of inclusion bodies. With extraction and renaturation procedures, the yielding soluble hIL-4 exhibited biological activity, which promoted the proliferation of both human T cells and B cells. The successful expression of hIL-4 in E. coli will provide large quantities of this lymphokine for research and practical purpose.

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The Cloning and Expression of Invasion-Associated Protein Antigens of Shigella Flexneri Serotype 2a

40091014O Beijing ZHONGHUA
WEISHENGWUXUE HE MIANYIXUE ZAZHI
[CHINESE JOURNAL OF MICROBIOLOGY AND
IMMUNOLOGY] in Chinese Vol 10 No 3, Jun 90
pp 163-165

[English abstract of article by Liu Xuebo [0491 1331 0590], Kong Xiangying [1313 4382 5391], et al., Institute of Microbiology and Epidemiology, Academy of Military Medical Sciences, Beijing]

[Text] A large plasmid is found in virulent isolates of Shigella sp. and encodes functions essential for invasion factors and invasion of mammalian cell. In this study we used Cosmid pJB8, as a vector, to clone the plasmid DNA fragments of Shigella flexneri 2a and shotgun clone plasmid DNA directly into E. coli DH₁ recipients. Recombinant clones were screened by in situ hybridization of bacterial colonies with 17 Kb DNA probe. To demonstrate that the recombinant clones produced peptides, Western blot analysis of whole bacteria extracts was performed. In this way we succeeded in isolating four independent recombinants which could express invasion-associated protein antigens.

Key words: Invasion-associated protein antigen; Cosmid; Shigella; Gene cloning

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Expression of HLA I and II Antigens on Hepatocyte Membrane Compared With Infectious Status in Chronic Asymptomatic Hepatitis B Virus Carriers

40091014Q Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 3, Jun 90 pp 177-180

[English abstract of article by Hou Jinlin [0186 6855 2651] and Luo Kangxian [7482 2123 0341], Laboratory of Hepatitis Immunology, Nanfang Hospital, First Military Medical College, Guangzhou]

[Text] The relationship between infectious status and expression of HLA class I and II antigens were studied in 26 chronic asymptomatic hepatitis B virus carriers (AsC). The results revealed that both HBeAg positive and anti-HBe positive AsC have inactive hepatic lesions, but the detection rates of HBV DNA in serum and HBeAg in liver were 92 percent (11/12) in the HBeAg positive carriers, whereas no one was found in the anti-HBe positive carriers. We also found that the density of HLA I and II antigens on hepatocyte membrane in the HBeAg positive AsC was higher than that in the anti-HBe positive carriers. Our findings suggest that HBeAg positive and anti-HBe positive AsC are in different stages of viral replication and host immunity.

Key words: Chronic HBV asymptomatic carrier; HLA class I antigen; HLA class II antigen; Immunohistochemistry

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Fc Receptor Expression in Patients With Chronic HBV Infection

40091014I Shanghai ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 8 No 2, May 90 pp 81-83, 76

[English abstract of article by Li Yali [2621 0068 0048], Kong Xiantao [1313 2009 3447], et al., Changsheng Hospital, PLA Second Military Medical College]

[Text] In order to explore the association of Fc receptor (FcR) expression in patients with chronic hepatitis B virus infection (CHBVI) and their defects of immunity, FcR (for IgG & IgM) in peripheral blood lymphocytes (PNL), labeled with biotinylated aggregated IgG, biotinylated [as published] IgM and avidin conjugated FITC, were analysed by flow cytometry. It was found that FcR (for IgG) was not normally expressed in the lymphocytes of patients with CHBVI. The percentage of FcR positive PBL in CHBVI patients (21.29 +/- 5.66) was significantly reduced as compared with healthy controls (36.63 +/- 9.07) and convalescent hepatitis B patients (41.78 +/- 10.02) (P less than 0.001), while the percentage of PcuR (for IgM) positive PBL in CHBVI patients (13.33 +/- 5.60) was nearly the same as in healthy controls (12.77 +/- 5.39). These results imply that the abnormal FcR expression may play a key role in the development of CHBVI.

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Preparation of Human Minisatellite DNA Probes

40091014F Beijing *YICHUAN XUEBAO* [ACTA GENETICA SINICA] in Chinese Vol 17 No 3, Jun 90 pp 226-229

[English abstract of article by Guo Guangming, Qiu Xinfang, Hong Xiankang, Xu Haiguang, Qin Shizhen, Jiang Zuoshu, and Xue Jinglun, Institute of Genetics, Fudan University]

[Text] A 23-mer oligonucleotide based on the core sequence was chemically synthesized and used to screen the human genomic library. Fifteen positive recombinants containing the minisatellite sequences were identified, and one of them, C_{35.9}, was used to perform Southern hybridization with the DNAs from unrelated Chinese individuals. Each sample has 3-11 hybridizing bands, and some of which are polymorphic. The band patterns detected under controlled condition are individual-specific in a limited population. This indicates that the minisatellites obtained by screening the library can be used to detect the polymorphisms of the minisatellites. Project supported by the National Natural Science Foundation of China.

Key words: Minisatellite DNA, DNA polymorphism, Oligonucleotide

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Quantitative Analysis of the DNA Genome of HBV by Blot-Hybridization

40091014P Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 3, Jun 90 pp 174-176

[English abstract of article by Bai Wei [4101 5633], National Vaccine and Serum Institute, Beijing, and Jing Guozhong [7234 0948 1813], Institute of Biophysics, Academia Sinica, Beijing]

[Text] Plasmid pBRHB125 containing HBV genomic DNA insert was extracted from *E. coli*. The HBV DNA was prepared by agarose gel electrophoresis after cleavage by restriction endonuclease BamHI. Purified HBV DNA and pBRHB125 as the DNA probes were then labeled with 35-s-dATP by nick translation method respectively. In this study, the sensitivity of those two types of probe has been compared by dot hybridization. The results indicated that both types of probe had almost the same sensitivity of 4pg. At the same time, quantitative analysis of HBV DNA in serum specimens was investigated in asymptomatic the hepatitis B carriers who were HBeAg positive. In 5 normal sera detected, there was no HBV serological marks, HBV DNA were all negative. However, another 5 serum specimens which were HBsAg (CEP) and HBeAg (ELISA) positive gave positive results. The range of HBV DNA in the samples was about 60-600pg/ml. This study may serve as a general method for diagnosis and quantitative analysis of HBV and other viral genome DNA.

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Detection of Epidemic Hemorrhagic Fever Virus Antigen and IgG in Neutrophils of Patient With Epidemic Hemorrhagic Fever

40091014J Shanghai ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 8 No 2, May 90 pp 84-87

[English abstract of article by Zhu Xiangxiu [2612 0686 4423], Gao Cong [7559 5115], et al., Health and Anti-Epidemic Station of Huainan City, Anhui Province]

[Text] Epidemic hemorrhagic fever (EHF) virus antigen and IgG were detected by indirect and direct immunofluorescent antibody staining technique respectively. The specimens included 38 peripheral blood (PB) and 14 bone marrow (BM) samples from the patients with EHF. Twenty-seven PB and 22 BM samples from non-EHF patients and 29 PB and 4 BM samples from healthy persons served as controls. EHF virus antigen and IgG were found in neutrophils of PB (97 percent) and BM (93 percent) of the patients, while no virus antigen was found either in neutrophils of PB or bone marrow of non-EHF patients and healthy persons. Although IgG was positive in neutrophils of PB (4 percent) and BM (25 percent to 33 percent) in non-EHF patients and healthy persons, it indicated that the presence of IgG was not related to EHF.

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A Novel Type of Phase Variation Regarding Integrated and Free States of Plasmid pFDX163 in *Bacillus stearothermophilus* CU21

40091014E Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 17 No 3, Jun 90 pp 216-225

[English abstract of article by He Xiaosong [0149 4562 2646], Shen Renquan [3088 0088 2938], et al., Institute of Genetics, Fudan University, Shanghai]

[Text] pFDX1 is a recombinant plasmid which carries a foreign gene *xylE*. By selecting for kanamycin-resistant mutants of *Bacillus stearothermophilus* CU21(pFDX1) at higher temperature, a variant strain CU21-163 was obtained. This strain harbors a mutant plasmid pFDX163, which was formed by insertion of a 2.0 kb H-fragment from the CU21 genome onto the plasmid pFDX1. pFDX163 was supposed to be integrated into the CU21 chromosome via homologous recombination of H-fragments. The CU21-163 strain consists of two cell types, i.e. y-cell and w-cell. The expression level of *xylE* gene in the former is higher than that in the latter. The progeny of a y-cell always contains some w-cells, while that of a w-cell contains y-cells. This is supposed to be due to a phase variation of CU21-163. Analysis on the amount of free and integrated plasmid DNA in different DNA samples of CU21-163 cells allows us to draw the conclusion that there are both free and integrated plasmids in the y-cells, whereas only integrated ones in the w-cells.

Key words: Thermophile, Phase Variation, *xylE* gene

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Study on Immunogenicity of HBsAg Bound to Anti-HBs of Different Affinities

40091014G Shanghai ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 8 No 2, May 90 pp 69-71

[English abstract of article by Qian Lisheng [6929 0448 3932], Zhang Deqiang [1728 1795 1730], et al., Department of Microbiology, Shanghai Medical University]

[Text] High and low affinity monoclonal antibodies bound to HBsAg (S_5 , high affinity and S_6 , low affinity)

were used to immunize Balb/C mice to study their effect on the immunogenicity of HBsAg. It was found that HBsAg bound to S_5 induced lower antibody titer (\log_{10} 1.43 \pm 0.67) than that of HBsAg bound to S_6 (\log_{10} 1.65 \pm 0.62). It is postulated that low affinity anti-HBs (S_6) is less efficient in clearance of HBsAg which persists longer in mice to induce higher antibody titer.

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Study on the Molecular Forms of Plasma Fibronectin in Patients With Severe Viral Hepatitis

40091014H Shanghai ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 8 No 2, May 90 pp 72-76

[English abstract of article by Guan Peilong [1351 1014 7893], Wang Weiye [3076 0251 2814], et al., Department of Infectious Diseases, Changhai Hospital, PLA Second Military Medical College, Shanghai]

[Text] The plasma fibronectin (PFn) level decreased significantly in 27 patients with severe type of chronic active hepatitis B. Obvious correlations were found between the level of PFn and the value of prothrombin activity and total serum bilirubin, the occurrence of complications and the prognosis, suggesting that the level of PFn could reflect the severity of the illness and the prognosis of these patients. Patients with low PFn level were susceptible to develop endotoxemia. Obvious correlations were also found between the level of PFn and the values of complement 3 and blood platelet count. Alpha 2-antiplasmin-plasmin complex appeared in 11 of 27 patients, which demonstrated the increased amount of plasmin in part of these patients. No PFn degradation products could be detected in plasma of these patients by Western blot. This excluded the

hypothesis that the lowered level of PFN in these patients could be the degradation of fibronectin by proteolytic enzymes released as a result of liver injury and associated coagulopathy. It seems that it is possible to give the PFN replacement therapy to these patients.

Key words: Fibronectin; hepatitis B; α_2 -antiplasmin-plasmin complex; Western blot

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A New Single Point Mutation at the Initiation Codon (ATG-AGG) Identified in Amplified Genomic DNA of a Chinese With β -Thalassaemia 40091014K Beijing ZHONGHUA YIXUE ZAZHI [NATIONAL MEDICAL JOURNAL OF CHINA] in Chinese Vol 70 No 5, May 90 pp 258-261

[English abstract of article by Xie Shensi [6200 1957 1835], Hunan Medical University, Changsha, and Tan Rongan [6223 2837 1344], University of Hong Kong]

[Text] A new single nucleotide change at nt 2 of exon 1 of the β -globin gene was identified in a Chinese female patient with β -thalassaemia. Dot blot hybridization of the amplified genomic DNA with oligonucleotide probes showed that she carried the four base deletions at the codons 41/42. Direct DNA sequencing on the amplified DNA revealed that she also carried a new mutation (ATG-AGG) at the initiation codon on the other β -globin gene. This single nucleotide change abolishes a NcoI recognition site and hence it can be directly visualized after gelelectrophoresis. Analyses of restriction fragment length polymorphisms showed that she also carried a rightward -3.7 kb (type I) deletion in her α -globin genes, and is in fact a $\alpha\beta$ -thalassaemia genotype.

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Establishment of CPE and Plaque Methods for Rabies Virus Titration

40091014R Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 3, Jun 90 pp 191-194

[English abstract of article by Li Hengling [2621 1347 3781], Li Hemin [2621 3109 3046], et al., National Institute for the Control of Pharmaceutical and Biological Products, Beijing]

[Text] Rabies virus strains C42-V8, C103-V9 and 4aG-V8 are obtained from CTN-1 and 4aG which were adapted to Vero cells. Thus, rabies virus CPE and plaque methods were established by inoculation viruses into suspended Vero cells.

CPE and plaque methods are proved to be highly specific, sensitive, and stable methods with the advantages of good reproducibility and easy handling. By using these methods, the test period can be shortened from 10 days to 4 days. Up to now, the methods have been applied to the virus identification, virus cloning and virus titration tests as well as the determination of the titer of rabies anti-sera.

Key words: Rabies virus; Cytopathogenic effect; Plaque method

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Screening of the Catalase Producing Thermophilic Microorganisms and the Conditions for Enzyme Productions

40091014A Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 30 No 3, Jun 90 pp 223-227

[English abstract of article by Zhou Yi [0719 0001], Yan Zizheng [0917 5261 2973], et al., Institute of Microbiology, Academic Sinica, Beijing]

[Text] From 59 thermophilic Actinomyces strains, the authors screened out a promising strain *Thermostreptomyces* sp. T485 with extracellular catalase producing capacity. The optimum catalase producing conditions showed as follows: temperature, 50°C; initial pH of medium 6-8; carbon source, maltose; nitrogen source, yeast extract and cultured for 48 h on shaker with 30-50 ml medium in the 250 ml flasks. Under these conditions the catalase activity reached 140 u/ml. The project supported by National Natural Science Foundation of China.

Key words: Catalase; Thermophilic actinomyces; *Thermostreptomyces* sp.

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Rapid Identification of Mycobacterium Tuberculosis and Other Mycobacteria With Mycobacterium Tuberculosis Whole Chromosomal DNA Probe

40091014B Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 30 No 3, Jun 90 pp 234-237

[English abstract of article by Wu Xueqiong [0702 7185 8825], Zhuang Yuhui [8369 3768 6540], et al., Tuberculosis Center, 309th Hospital of PLA, Beijing, Huang Peitang [7806 1014 1016] and Li Fengsheng [2621 0023 3932], Molecular Genetics Center, the Academy of Military Medical Sciences, Beijing]

[Text] The dot-blots containing DNA isolated from nonmycobacterial and mycobacterial microorganisms were hybridized with ³²P-labeled M. tuberculosis whole chromosomal DNA at the various temperatures. The probe did not cross-hybridize to DNA of nonmycobacterial microorganisms (E. coli, Plasmid pUC19, Nocardia asteroides), nor with DNA from all mycobacteria tested except M. bovis BCG under the higher temperature conditions. Microorganisms could also be directly spotted and lysed on nitrocellulose filters and used for hybridization thus making this technique suitable for clinical diagnosis.

Key words: DNA probes; M. tuberculosis; Mycobacterium

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Cell Selection of the Tobacco Mutant Resistant to Black Shank Disease

40091014C Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 17 No 3, Jun 90 pp 180-188

[English abstract of article by Zhou Jianmin [0719 0313 3046], Liang Sixin [2733 1835 0207], et al., Institute of Genetics, Academia Sinica, Beijing]

[Text] Using tobacco anther culture and toxin selection, a selecting system of tobacco black shank disease resistant mutant has been set up. The system consists of the following steps: 1) Anthers of susceptible varieties are mutagenized with γ-ray 500-2000 rods. 2) Screening toxin tolerant pollen plants in anther culture medium containing 50-80 percent crude toxin. 3) Disease resistance of the toxin tolerant pollen plants is tested with in vitro leaf-assay method. 4) The resistance of the offsprings of disease resistant plants is retested, and the plants of which resistance can be transmitted through sexual reproduction are considered to be disease resistant mutants. Both the treatment of γ-ray and high toxin concentration can give disease resistant pollen plants. About 9-50 percent of the pollen plants produced by either of the two treatments have shown disease resistance. Some of these plants can produce resistant offsprings while some can not. Using this system, we have got 6 resistant mutants from 2 highly susceptible varieties and 4 resistant lines from 2 F₁ hybrids of Res. Var. X Suscept. Var. with stable resistance within 3-4 generations. Resistance of the mutant R-400, selected from a susceptible variety "Small Golden 1025", seems to be controlled by multiple genes with an incomplete dominance.

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Study on Antifreeze Protein in Fishes II. The Cloning of Antifreeze Protein Gene cDNA of *Pseudopleuronectes yokohamae* and Its Expression in *E. coli*

40091014D Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 17 No 3, Jun 90 pp 202-210

[English abstract of article by Jiang Yaoqing [5592 5069 7230], Chen Xiongfeng [7115 7160 7364], et al., Institute of Genetics, Academia Sinica, Beijing]

[Text] *Pseudopleuronectes yokohamae*, existing in the Yellow Sea of China, contains antifreeze peptide (AFP). This protein could depress the serum freezing point. On the basis of purification and characterization of this protein, we synthesized a segment of Oligo-nucleotides of antifreeze protein gene as a primer and hybridized with the mRNA of *Pseudopleuronectes yokohamae*. The cDNA of antifreeze protein gene has specifically been reversely transcribed. This segment has been cloned onto pUC19 with Ecor I linker method. After confirmation of the insert segment of the cDNA of antifreeze protein gene, the zymogram was detected and the sequence of the nucleotides was determined. This recombinant clone was transformed into *E. coli* JM83 and expressed well. This project was supported by the Bureau of Aquatic Products, Ministry of National Agriculture, Animal Husbandry and Fishery.

Key words: *Pseudopleuronectes yokohamae*, cDNA clone, Antifreeze peptide, Expression in prokaryotes

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Determination and Assessment of Respiratory Resistance for Aircraft Oxygen Equipment

40091014L Beijing JIEFANGJUN YIXUE ZAZHI [MEDICAL JOURNAL OF CHINESE PEOPLE'S LIBERATION ARMY] in Chinese Vol 15 No 3, Jun 90 pp 175-178

[English abstract of article by Ma Ruishan [7456 3843 1472], Ni Heying [0242 7729 7761], et al., Department of Aviation Physiology, Fourth Military Medical College, Xi'an]

[Text] The respiratory resistance of the aircraft oxygen equipment currently used in our armed forces was investigated. The results showed: 1) When ventilation was 20 L/min, the mask cavity pressure swing (P) of YX-1 system was 0.98 kPa, and that of YX-3 system 0.91 kPa. Their difference was significant. 2) The sensation magnitude was between light and moderate when sit still or with mild exertion, while it was moderate during moderate exercise. The resistant sensation of YX-3 system was lower than that of YX-1 system, but there was no significance statistically (P greater than 0.05). 3) With YX-3 system being used for 30 min with light physical activity, adaption of respiratory resistant sensation was

not observed. 4) The respiratory resistance of two kinds of oxygen system was too high, and lowering is recommended.

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A Preliminary Study on Stability of the Form I Plasmid of Shigella Sonnei

40091014N Beijing ZHONGHUA
WEISHENGWUXUE HE MIANYIXUE ZAZHI
[CHINESE JOURNAL OF MICROBIOLOGY AND
IMMUNOLOGY] in Chinese Vol 10 No 3, Jun 90
pp 159-162

[English abstract of article by Liu Wei [0491 0251], Wang Bingrui [3769 4426 3843], et al., Lanzhou Institute of Biological Products, Ministry of Public Health]

[Text] A preliminary study on the stability of Form I plasmid of Shigella sonnei was carried out by analysis of the strain of Shigella sonnei S₇ and its Form II strain S₇R. Strain S₇ preserved the plasmid steadily even after 20 passages.

The biological properties of strains S₇, S₇R conformed to those of Form I and Form II of Shigella sonnei respectively. A virulent strain of Shigella sonnei S₅₁₂₋₃₅ was used as control. By utilizing transposon Tn5 insertion and F⁺ plasmid mobilization, we transferred the large plasmid of strains S₇ and S₇R to a recipient strain of Shigella sonnei Form II to observe the stability of these strains. It was found that the large plasmid which originated from S₇ and S₇R was still harboured in the recipient, while the 120 Md plasmid which came from the virulent strain S₅₁₂₋₃₅ was not, when the stabilities of the plasmids from rough recombinant strains were isolated and tested. The experimental results of the present study suggest that the stability of Form I plasmid of Shigella sonnei is more closely related to the plasmid itself than to the host cell, since the difference between the strains S₇, S₇R and S₅₁₂₋₃₅ consisted in the fact that there was a deletion of large plasmids (about 36-50 Md) in the former two strains.

Key words: Shigella sonnei (Form I/II); Plasmid; Stability; Plasmid mobilization

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Improved Fuzzy Controller Used in Polymer Plant

90P60048 Beijing ZIDONGHUA XUEBAO [ACTA
AUTOMATICA SINICA] in Chinese Vol 16 No 3
May 90 pp 258-261 (MS received 30 Oct 87)

[Article by Dai Zhongda [2071 1813 6671], Zhang
Zengke [1728 2582 4430], and Tang Jian [3282 0313] of
Qinghua University: "An Improved Fuzzy Controller
and Its Application"]

[Summary] In order to overcome the disadvantages of
the conventional (i.e., single-input) fuzzy controller, a
new hybrid control system consisting of a multi-input
fuzzy controller and a PID (proportional-
integral-differentiated or proportional-plus integral-plus

derivative) cascade regulator is described. This hierar-
chical, multi-rule-based control system has been imple-
mented at the Nanjing Zhongshan [6988 1472] Chemical
Engineering Plant's Emulsifier Shop for temperature
control of the semi-batch polymer vat production pro-
cess. The emulsifier is produced by a chemical reaction
of an intermediate with ethylene oxide at a specific
temperature and in the presence of a catalyst.

Via the new system, the temperature vacillation range of
the process can be controlled to within plus or minus ten
degrees either side of 160°C; furthermore, after instabil-
ities in the reaction process are evened out, the PID
cascade regulator can control the vat temperature to an
accuracy of 1 percent. Actual economic benefits derived
from the application of the system in 1986-1987 have
been measured at 1.08 million yuan annually per vat.

Further Reports on Computer Virus Prevention, Outbreaks

Papers at Conference on Computer Security

90P60058a Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 29, 25 Jul 90 p 3

[Article by Shang Mu [1424 2606]: "Topic of Computer Security Draws Widespread Attention: Fifth National Computer Security Conference Held at Huangshan"]

[Summary] At the Fifth National Computer Security Technical Interchange Conference held at Huangshan in Anhui Province, June 19-24, of a total of 170 papers received, 32 were discussed, including a number of technical papers devoted to prevention and detection of computer viruses, as well as computer network security. The U.S. computer firms IBM and Unisys sent special representatives to introduce their firms' computer security techniques and products. Also at the conference, the Ministry of Public Security announced that it had dispatched virus-elimination diskettes to the public security departments of all provinces and municipalities and is permitting users to copy the software gratis.

Situation in Shaanxi Province

90P60058b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 29, 25 Jul 90 p 2

[Article by Bai Yu [4101 7183]: "Shaanxi Province's Public Security Department Adopts Measures to Monitor Computer Security"]

[Summary] Following upon the spirit of several documents issued by the State Council, the Ministry of Public Security, and relevant offices of the Shaanxi Provincial Government, the Office of Computer Security Supervision (OCSS) in the Shaanxi Province Public Security Department has since February of this year taken various administrative, technical, and legal measures to control outbreaks of computer viruses in the province, including examination and eradication of viruses in 475 computers at 78 work places and restoration of over 30 computers that had been damaged by virus attacks. OCSS has conducted an active campaign to instruct individuals and work units in proper procedures and the use of virus-elimination software products. Since the first virus was discovered in the province in June of last year, two peak outbreaks have occurred in which some computer facilities have experienced grave dangers such as loss of data, leakage of secrets, chaos in calculation results, and (for scientific research, educational, and medical treatment institutions) inability to conduct normal operations.

Situation in Guangxi Province

90P60058c Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 29, 25 Jul 90 p 3

[Article by Zhang Keqian [1728 0344 0578]: "Guangxi Begins to Get Rid of Eight Computer Viruses"]

[Summary] The Guangxi Province Public Security Department recently began an investigation into and elimination of the eight varieties of computer virus that

have been discovered in the province. The viruses have spread principally via magnetic media—disks and tapes—as well as through computer networks. Serious problems such as damage to input programs and system "lock-up" have been observed. Of the eight viruses discovered to date in the province, the most common are the "Ball" Virus, the "Marijuana" Virus, and the "Friday the 13th" Virus. The number of work places that have reported the discovery of viruses to the Public Security Department is 22 as of today, and the number of virus-elimination diskettes sent out by the department so far is 37. Special attention is being paid to the banking and financial system, scientific research institutes, universities, specialized institutions of higher education, and units of the Party and government.

Situation in Shanghai Municipality

90P60058d Shanghai JIEFANG RIBAO in Chinese 29 Jul 90 p 6

[Article by Liu Bin [0491 2430]: "Computer Viruses Quietly Spreading in Our City"]

[Summary] Computer viruses have posed a grave threat since they were first discovered one after another throughout China in April 1989. In a survey of 12,750 computers across the nation conducted at the end of 1989, authorities found that 2550—or 20 percent—had caught the "Ball" Virus. Shanghai Municipality, with more computers than any other city in the nation, has also had its problems. According to information released, over 240 computers at 22 offices and departments in the Shanghai area had been infected, but the actual number is in reality much higher, since only those computers in which a virus was discovered were included. Authorities have inferred that the infected computer rate for the Shanghai area must be about 15 percent higher than the national average of 20 percent, strongly suggesting that computer users here are still not paying sufficient attention to computer viruses.

On Friday, April 13 this year, two container loading/unloading firms located in the northeast quadrant of the municipality on Jun Gong Road and Zhang Hua Shore Road were busy as usual. These firms, which utilize computers daily to track the volume going through the harbor, experienced strange events that day: when operators attempted to input instructions into their computers, chaotic operations commenced and data stored in memory was inexplicably lost. The computer personnel quickly realized that their machines had fallen prey to the predicted "Black Friday" [i.e. "Friday the 13th"] Virus. All computers at these two shipping firms were paralyzed; data which had taken much time to gather was destroyed in a moment, with concomitant severe economic and operational losses. Naturally the

Ministry of Public Security, anticipating another outbreak on July 13 (another Friday the 13th), in early July alerted authorities to be especially vigilant on the 13th.

The "Marijuana" Virus, in comparison, has been relatively hidden. One day in late April this year, the computers at one of the shops of the Shanghai Solvent Plant caught the Marijuana Virus. Since these computers were used for temperature control, there was serious danger of explosion if the temperature of the solvent departed from the allowable range. Operators lost no time replacing the infected computers, but could not be sure that the new computers were not themselves infected with some computer virus. Finally, they contacted the Public Security Department's Computer Oversight Office, which dispatched personnel to inspect the replacement computers.

China does not have home-grown computer viruses; they have all been brought in from abroad. The reasons for the spread of viruses are numerous, but all revolve around supervision of computer use, specifically as follows:

- (1) Repeated applications and light security. Analysis of the computer viruses prevalent in our municipality has shown that a good percentage of attacks can be traced to students returning from studies abroad and bringing back with them diskettes copied from infected software. This has happened often at institutions of higher learning. The "Trojan Horse" phenomenon—wherein foreigners harboring malicious intentions have taken advantage of Chinese computer users by implanting a virus into computer spare parts or components that are then sold to the Chinese users—has also been seen.
- (2) The necessary rules and regulations have not been amplified. Management and supervision is in a very disordered state. Especially troublesome are the failure of users—and of their supervisors—to thoroughly check diskettes with an unknown history and the widespread bad habit of playing computer games (which are easily copied and therefore spread any virus) on office computers.
- (3) The proper laws have not been implemented. Some firms are seeking exorbitant profits by putting overly high-priced virus-elimination software on the market. Even worse, some intentionally market such products knowing full well that the products themselves contain viruses which can then spread.

Software Developments Reported

Engineering Modelling & Simulation System

90P60046a Beijing JISUANJI SHIJIE [CHINA
COMPUTERWORLD] in Chinese No 27,
11 Jul 90 p 18

[Article by Li Dasheng [2621 1129 3932]: "Engineering Product Modelling and Simulation System EMSS"]

[Summary] In an effort to popularize the use of three-dimensional graphics systems on a microcomputer—as opposed to the traditional small-to-mid-sized workstation—Central China Science & Engineering University's CAD Center has developed a functionally complete engineering product modelling and simulation system, called EMSS for short. The system has applications in areas such as design of modular machine tools, design and motion simulation of engineering machinery, modelling and finite-element pre/post-processing of high-voltage electrical equipment, design of industrial robots, and dynamic simulation of the cutting processes of machine tools used in FMCs [flexible machining cells]. The system requires a PC with color monitor and graphics card, a plotter, and a printer, and runs under the DOS3.3 operating system. Programming languages include Turbo-Pascal and macroassembly language.

Conceptual Design Expert System Tool

90P60046b Beijing JISUANJI SHIJIE [CHINA
COMPUTERWORLD] in Chinese No 27,
11 Jul 90 p 18

[Article by Wang Qun [3769 5028]: "Electromechanical Product Conceptual Design Expert System Development Tool CDES TOOL"]

[Summary] In 1989, Central China Science & Engineering University's (CCSEU) CAD Center developed an electro-mechanical product conceptual design expert system development tool CDES TOOL. This system was developed upon three independent systems: an overall conceptual design expert system for industrial steam turbines (TDES), a conceptual design expert system for wheeled loading machines (WLCDES), and a conceptual design expert system for numerically controlled milling and boring machining centers (MCCDES). Now, CCSEU has teamed up with Qinghua University and the Beijing No 1 Machine Tool Plant to develop a CDES tool for planer-type milling-machine feed systems. This software system can run on a MicroVAX-II or GPX workstation and uses the VMS operating system; languages include COMMON LISP (for basic programming), FORTRAN, Pascal, C, and Workstation Graphics Language.

Programmable Array Logic Tool

90P60046c Beijing JISUANJI SHIJIE [CHINA
COMPUTERWORLD] in Chinese No 27,
11 Jul 90 p 20

[Article by Li Rukun [2621 1172 2492]: "Practical PAL Logic Programming & Analysis System PAL-TOOL"]

[Summary] Developed by a superworkstation group from the Chinese Academy of Sciences' Institute of Computing, a programmable array logic (PAL) programming and analysis system called PAL-TOOL has been used to design over 500 programmable logic devices (PLDs), and should prove to be a powerful state-of-the-art tool for domestic digital systems designers and

educators. This is an integrated system for the design of PAL, hard array logic (HAL), programmable logic (PL), generic array logic (GAL), and erasable programmable read-only memory (EPROM) devices, as well as for the analysis of foreign-made devices of these types. The hardware system required to implement PAL-TOOL includes one microcomputer and one workstation connected via Ethernet.

Optical CAD System

90P60046d Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 28, 18 Jul 90 p 2

[Article by Xuan Gang [1357 0474] and Han Yun [7281 0061]: "Gold Star Computer-Aided Optical Design System (VCAD) Developed in Beijing"]

[Summary] A computer-aided optical design (optical CAD) system capable of accurately describing the nature of optical systems and graphically reproducing optical phenomena has recently been developed by the Gold Star Computer Engineering Company in Beijing. This indispensable graphics/Chinese-character software tool for the optical industry, scientific research institutes, and educational institutions can be run on a Macintosh-II computer using C language. A wide array of functions—including optical path computation; diapoint [i.e., point-range plot] design; and wave-difference, point-spread, and optical transfer function calculations—is included. In addition, automatic corrections can be carried out via the damped least square method, generalized inverse square method, and the orthogonalizing method.

BIOS 4.0 Operating System

90P60046e Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 28, 18 Jul 90 p 22

[Article by Gao Yuqian [7559 3022 0051]: "Shanghai Computer Plant Releases Donghai BIOS 4.0 System Software"]

[Summary] To promote applications of Chinese-language information processing technology and applications of its Donghai DOS operating system, Shanghai Electronic Computer Plant has recently put out a new product for its Donghai series of microcomputers: Donghai BIOS 4.0 system software. This Chinese/English operating system comes with a choice of seven display cards, runs on IBM PC DOS V2.0 or higher, and

is rated higher in range of functions (flexibility, portability, maintainability, fault tolerance, Pinyin inputting, associative performance, symbol inputting, and user interface) than CCDOS4.0. With an open system structure, it provides numerous applications programs and maintenance routines. Chinese-character inputting is via the fault-tolerant six-key Pinyin method.

Key State Lab Accredited

90P60046f Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 29, 25 Jul 90 p 2

[Unsigned article: "Nanjing University's New Software Technology Lab Passes State Acceptance Check"]

[Summary] The New Software Technology Key State Laboratory at Nanjing University, having completed 23 research projects and having won nine state awards, recently passed its state-level acceptance check. Among the 23 PhDs [in computer science] throughout the nation, 12 have trained at the lab at some time in the past 3 years. Built on the approval of the State Planning Commission and the State Education Commission 3 years ago (formal opening 30 June 1987), this lab has conducted research in intelligent systems, automation, parallel processing, integration, natural language, distributed computing, and new program design, including three "863 Plan" high-tech research projects. Laboratory researchers have published 170 papers at international conferences, as well as six special treatises.

New Corporation Established

90P60046g Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 26 Jul 90 p 1

[Article by Ji Hongguang [1323 3163 0342]: "China Computer Software and Technical Services Corporation Set Up"]

[Summary] On 25 July, the China Computer Software and Technical Services Corporation was established. This backbone facility for research, development, and production of computer software has been formed on the basis of the Ministry of Machine-Building & Electronics Industry's former China Computer Software Technology Company and China Computer Technical Services Company. Of the almost 1000 personnel in the new venture, over 72 percent are engineers and technicians, including about 500 senior technicians with master's degrees or higher.

Developments in Underwater Robots by Shenyang Institute

40100071 Beijing CHINA DAILY in English 10 Aug 90
p 5

[Article by Ji Ren: "Underwater Robots Remove Guess-work"]

[Text] In September 1987, the Fengman Hydropower Station in Jilin Province had a problem.

The station needed to increase its intake in order to provide more power. The simplest solution was to re-activate two intake channels which had been shut off years earlier, yet no one was sure if the sides of the channel were structurally sound.

Divers were sent down to examine the steel walls, but like blind men sizing up an elephant, they came back with different assessments. Sometimes even the same diver would bring back contradictory reports, since he was unable to stay in the deep water for long and what he saw—or felt, to be exact—was only a small part of the immense structure.

Before long, however, leaders at the power plant had the answer. By studying a videotape of the lake bottom and the intake channels, they were able to tell exactly where repairs were needed. The old channels were re-activated at a fraction of the cost of building new ones, and the expansion of the plant was soon completed.

The vital videotape was shot by the Goldfish-3 (JY-3), a remote-controlled, underwater vehicle just completed by the Shenyang Institute of Automation.

"The success of the JY-3 was inspiring," said Feng Xisheng, deputy head of the Institute's Department of Underwater Robot Development and Application.

He noted that China has about 20,000 reservoirs, some of which were completed during the 1940s and require urgent maintenance.

Small, lightweight, and capable of working at a depth of 100 metres, the JY-3 has already proven invaluable in a host of scientific and industrial applications.

The Institute's development of underwater robots began in the late 1970s, but really got underway in 1982, when the project was approved as a major research programme by the Chinese Academy of Sciences, with a budget of 1.15 million yuan (\$244,681).

Three years later, HR-1 (Seaman-1), China's first underwater vehicle, was born. After a year of initial trials in Bohai Bay, HR-1 completed its first assignment, picking up designated objects 200 metres beneath the South China Sea.

Next, the Institute signed a contract with the Perry Company of the United States and began construction of the Recon-IV, a medium-sized vehicle for underwater rescue, salvage, and deep sea construction.

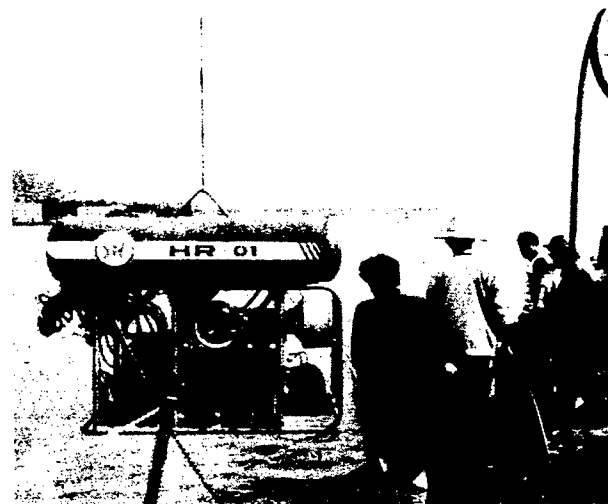
All three versions of the Chinese-made Recon-IV are equipped with audio-visual systems, manipulators, hydraulic scissors, emery wheel systems, and cleaning brushes. More than 90 percent of the parts are made in China.

To date, most of the Institute's robots are powered and manipulated from the surface via cables.

As part of the high-tech "863" project, however, the institute is now working on untethered robots which will react to their environment and make decisions on their own. Such "intelligent" robots require complex control systems and probably will not be applied widely in China until the mid-1990s.

Development of the underwater robots has brought together a dedicated group of scientists and technicians. One foreign expert, marvelling at his Chinese counterparts' efficiency in robot repairs, called them "magicians."

Magicians or not, they will be remembered as the pioneers of China's robot industry.



HR-01 (Seaman-01) is China's first underwater robot. Built in 1985 by the Shenyang Institute of Automation, HR-01 can pick up designated objects from 200 metres below the sea.

Monostatic Radar Cross Section for Reflector Antennas

90P60051a Beijing DIANZI KEXUE XUEKAN
[JOURNAL OF ELECTRONICS] in Chinese Vol 12
No 4, Jul 90 pp 361-368 (MS received 20 May 89,
revised Sep 89)

[Article by Deng Shuhui [6772 2579 6540] and Ruan Yingzheng [7086 4481 6927] of the University of Electronic Science & Technology of China, Chengdu]

[Abstract] Using Geometrical Optics (GO) to calculate the specular field of reflector antennas and using the Method of Equivalent Currents (MEC)—derived from the Physical Theory of Diffraction (PTD) and the current line integral formula—to calculate the diffracted field at the edges, the formulas for calculating the monostatic radar cross section (RCS) [i.e., the RCS as seen by the same radar that emitted the pulse] of arbitrary rotary reflector antennas with arbitrarily polarized [i.e., considering both horizontally and vertically polarized] plane-wave incidence are derived. These formulas are intended to be used for reducing the RCS of the antennas and thereby improving the anti-radar stealth characteristics of aerial targets.

As an example of applying the formulas presented, the calculated monostatic RCS three-dimensional plots for a parabolic antenna with an aperture $2b = 0.6096$ meter and a focal length $f = 0.2522$ meter are given in figures 3-5 below [figs. 1-2 are illustrative of the geometric theory and are not reproduced] for three specific frequencies (2.3GHz, 4GHz, and 7.84GHz). The first two plots were derived with the MEC, while the third was derived by MEC when θ is less than or equal to 5° and by the Universal Theory of Diffraction (UTD) when θ is greater than 5° .

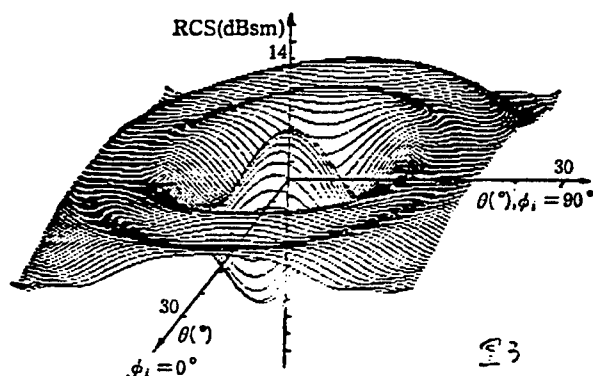


Fig. 3. Monostatic RCS 3-D Plot for $f = 2.3\text{GHz}$

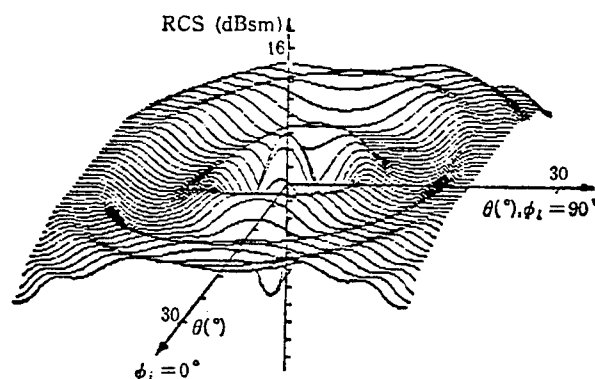


Fig. 4. Monostatic RCS 3-D Plot for $f = 4\text{GHz}$

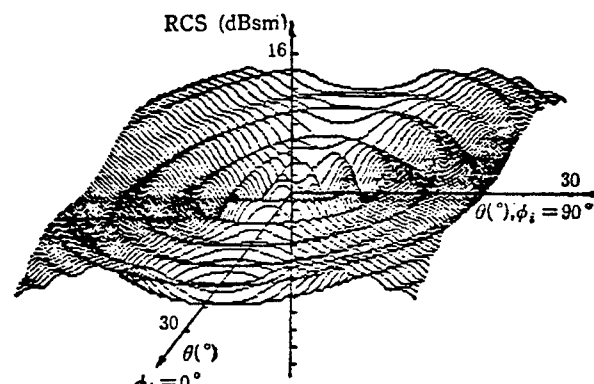


Fig. 5 Monostatic RCS 3-D Plot for $f = 7.84\text{GHz}$

Figures 6 and 7 below present the results calculated by a combination of MEC and UTD for frequencies of 2.3GHz and 4GHz, respectively, while figure 8 shows the results calculated by MEC for θ less than or equal to 5° and by UTD for θ greater than 5° for a frequency of 7.84GHz.

Finally, the results are compared with the experimental data of Kao presented in reference 2.

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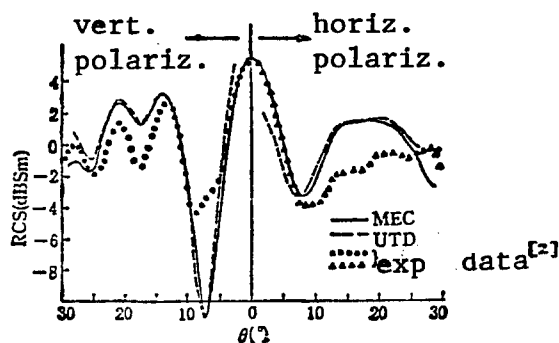


Fig. 6. Comparison of Theoretical with Experimental Results for $f = 2.3\text{GHz}$

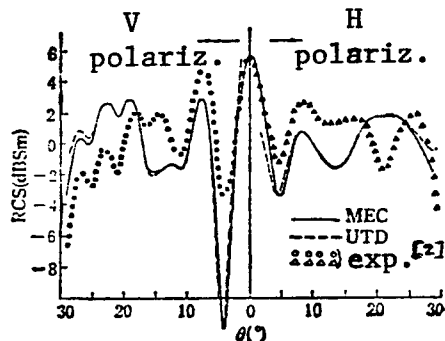


Fig. 7. Comparison of Theoretical with Experimental Results for $f = 4\text{GHz}$

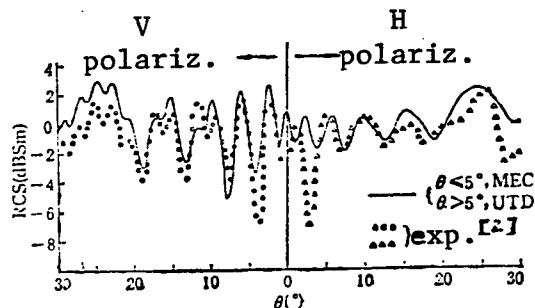


Fig. 8. Comparison of Theoretical with Experimental Results for $f = 7.84\text{GHz}$

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Improved Perturbation Analysis of Millimeter-Wave Dielectric Grating Antenna

90P60051b Beijing DIANZI KEXUE XUEKAN
[JOURNAL OF ELECTRONICS] in Chinese Vol 12
No 4, Jul 90 pp 378-384 (MS received 5 Dec 88, revised 27 Mar 89)

[Article by Xu Shan-jia [1776 0810 7468] and Wu Xin-zhang [2976 2450 4545] of China University of Science & Technology, Hefei]

[Abstract] An improved perturbation method is presented for analyzing the radiation characteristics of a millimeter-wave dielectric-grating leaky-wave antenna. The transverse resonance method is applied to determine the phase constants of the leaky-wave antenna, and the calculated values of the phase constants are then used to solve the active transmission-line equation. The calculated results are then rigorously compared with the values derived from the electromagnetic field-matching method, and shown to preserve accuracy while simplifying computations.

As shown in a figure [not reproduced], the values derived via the improved method are very close to those computed from the field-matching method. For the TE_0 mode, with $\epsilon_r = 2.1$, $t_g = 1.2\text{ mm}$, $t_r = 4.0\text{ mm}$, $d_1 = 2.0\text{ mm}$, and $d = 4.0\text{ mm}$, the two curves for the maximum radiation directivity of the leaky-wave antenna are basically a linear function of wavelength λ ; when λ is increased from 7.5 mm to 8.5 mm, the scanning angle is increased from 36° to 60° , and the mean scanning frequency is $4.9^\circ/\text{GHz}$.

Electron Orbits and Variation Character of γ in Electromagnetic Wigglers

40090023B Shanghai ZHONGGUO JIGUANG
[CHINESE JOURNAL OF LASERS] in English Vol 17
No 3, Mar 90 p 134

[English abstract of article by Zhou Shi'e, Feng Bibo, and Zhang Shichang, Department of Physics, Chengdu University of Electronic Science and Technology, Chengdu]

[Text] The electron trajectories in free-electron lasers with an electromagnetic wiggler and an axially guided magnetic field are analysed with the relativistic factor variable γ , which were usually assumed to be constant and the equations were linearized. A solution of the nonlinear relativistic equations of motion for such a system is presented. The results show that the electron trajectories are unstable, irregular, ring-shaped, corresponding to $\Omega_0/(\gamma_0\omega) =$, approximately equals, or less than, greater than $(1+u_{30})$ respectively. The condition for constant γ and hence a circle projected trajectory is given.

Key words: FEL, electron orbit variation character of γ

Temporal, Spatial, Energy and Polarized Properties of an Injection-Locked Copper Vapor Laser

40090023A Shanghai ZHONGGUO JIGUANG
[CHINESE JOURNAL OF LASERS] in English Vol 17
No 3, Mar 90 p 129

[English abstract of article by Ren Hong, Wo Mingzhen, Shen Qimin, He Mingxia, and Liang Peihui, Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, Shanghai]

[Text] We studied the temporal, spatial, energy and polarized properties of a copper vapor laser with plane-plane resonator into which a parallel polarized beam was injected. The results showed that comparing with the original oscillator, the output of such injection-locked copper vapor laser was increased by 43 percent, the degree of polarization from 0.30 to 0.78, the pulse width was broadened from 36 ns to 48 ns, the divergence of output beam was improved remarkably from 7.8 mrad to 1.1 mrad and approximately equal to that of the injecting beam.

Key words: copper vapor laser, injection locking, polarization

Investigation of Picosecond Double-Wave Band Short Cavity Dye Lasers

40090023C Shanghai ZHONGGUO JIGUANG
[CHINESE JOURNAL OF LASERS] in English Vol 17
No 3, Mar 90 p 140

[English abstract of article by Qian Liejia, Liu Yixian, and Li Fumin, Department of Physics, Fudan University, Shanghai]

[Text] Short cavity Rh6G dye laser with double-wave band output of yellow and red light pulses is reported. The temporal and spectral properties were studied experimentally. It was found for the first time that the temporal interval between yellow and red pulses can be measured by an autocorrelator. The double-wave band laser was studied theoretically.

Key words: short cavity dye laser, autocorrelativity, intercorrelativity

Computer Aided Analysis of a Simple Optoelectronic Integrated Circuit

40090025 Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 11 No 6, Jun 90 pp 453-458 (MS received 3 May 89)

[English abstract of article by Chen Weiyong, Hu Lizhong and Liu Shiyong, Department of Electronic Science, Jilin University, Changchun]

[Abstract] Using a computer aided analysis program for optoelectronic integrated circuits (OEICs), the small-signal modulation characteristics of hybrid and monolithic OEICs made up of a laser diode (LD) and two metal-semiconductor field effect transistors (MESFETs) are analyzed. It is considered that the LD bias I_o/I_{th} (I_o is the operating current, I_{th} is the threshold current) and the parasitic parameters of interconnecting wire and package affect the frequency-response characteristics and the small-signal pulse response characteristic of the laser output. The results show that the effect of the parasitic resistance and the capacitance under 5pF is not evident, but for the LD bias and parasitic inductance, the effect is very strong. At room temperature, when I_o/I_{th} is larger than 2, and the resistance and inductance of interconnecting wire are 0.1Ω and 0.3nH, respectively, the small-signal modulation band of the hybrid OEIC chip is as large as 4GHz. Because the monolithic OEIC decreases the parasitic inductance, it is useful for high-speed OEICs.

GaAs Metal-Insulator-Semiconductor Heterojunction FET Developed

90P60056 Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 11 No 7, Jul 90 pp 551-555 (MS received 2 Jun 89)

[Article by Yang Qinqing [2799 3084 3237], Gao Junhua [7559 0193 5478] et al. of the Chinese Academy of Sciences' Institute of Semiconductors, Beijing: "GaAs MISHFET Developed"]

[Summary] A new type of gallium arsenide field-effect transistor (GaAs FET) different from the GaAs MESFET (metal-semiconductor FET) and more closely resembling the high electron mobility transistor (HEMT) has been developed at the CAS Institute of Semiconductors. This new device, a GaAs metal-insulator-semiconductor heterojunction FET (MISHFET), fabricated by the molecular beam epitaxy (MBE) process, has the following structure, shown in Figure 1 below: semi-insulating (S.I.) GaAs substrate, covered by 3000-angstrom-thick undoped intrinsic GaAs (i-GaAs) layer, then a 600-angstrom-thick undoped $i\text{-Ga}_{0.6}\text{Al}_{0.4}\text{As}$ layer, and then a 100-angstrom-thick undoped i-GaAs layer.

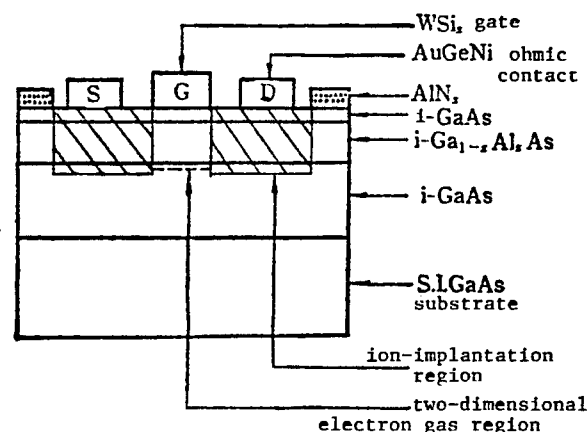


Figure 1. Structure of GaAs MISHFET

After the growth of these layers, RF (radio-frequency) sputtering was employed to deposit a 5000-angstrom-thick tungsten silicide (WSi_x) layer and reactive ion etching (RIE) with SF_6 ions was used to etch the $4\mu\text{m} \times 40\mu\text{m}$ gate (G) electrode out of the WSi_x . Then, with a positive photoresist as the blocking layer, selective self-aligned ion implantation (with Si as the ion impurity) was performed in the source and drain (S and D, respectively) areas. Afterward, in an N_2 atmosphere, unstable-state annealing was carried out to activate the ion impurities, and a layer of AuGeNi was evaporated onto the S and D areas to define the ohmic-contact electrodes. Then, reactive sputtering was again employed to deposit an AlN_x film as a dielectric layer for surface protection, and the final external leads were etched out.

A figure [not reproduced] shows the room-temperature I-V (current-voltage) characteristics of device sample A. Room-temperature transconductance of the sample measured 20-25 milliSiemens per millimeter and unblocked voltage was +1.4V. Gate voltage V_G was varied in a +.5V range around 1.4V. When V_G was less than 1.4V, drain-source current I_{DS} was very low, less than 1 microampere, but when V_G was raised to over 1.4V, I_{DS} was relatively high; the device's threshold voltage V_{th} is therefore +1.4V. This sample's GS and GD forward voltage drop was 1.2V, and reverse breakdown voltage was 8-10V.

The I-V characteristics of device sample B were then measured at room temperature and at liquid-N temperature (77K). Maximum I_{DS} was about 0.65 mA for a drain-source voltage V_{DS} of 5V at room temperature, and maximum I_{DS} was five times higher (about 3.25mA) for a V_{DS} of 5V at 77K.

Superconducting Properties and Structure of $\text{YBa}_2\text{Cu}_{3-x}\text{Sn}_x\text{O}_{7-y}$ System

40090024B Beijing DIWEN WULI XUEBAO
[CHINESE JOURNAL OF LOW TEMPERATURE
PHYSICS] in English Vol 12 No 3, May 90 p 205

[English abstract of article by Wang Yuxia, Ruan Yaozhong, Tang Yudong, and Wang Xiaozhong, Department of Materials Science and Engineering, University of Science and Technology of China, Hefei, Zhou Gui'en, Fan Chenggao, and Zhang Yuheng, Structure and Components Analysis Center, University of Science and Technology of China, Hefei]

[Text] The effect of Sn concentration on the superconducting properties and structure of $\text{YBa}_2\text{Cu}_{3-x}\text{Sn}_x\text{O}_{7-y}$ system were investigated systematically. The zero resistance temperature was found to be over 90K when x range from 0 to 1.1. No superconductivity was observed at liquid nitrogen temperature when x greater than 1.3. The X-ray diffraction patterns showed that the structure of 123 phase and a new phase change regularly as the Sn concentration increases. According to the TEM analysis, this new phase may be BaSnO_3 which has a deformed perovskite structure. About 6 percent of Cu were substituted by Sn in 123 phase when $x = 1.0$. We suggest that the new phase modulates the structure of 123 phase and stabilizes 123 phase. Since the Sn atoms enter the 123 phase and occupy the Cu sites in the Cu-O chain and break the Cu-O chain, but do not decrease T_c remarkable. [sentence as published] The Cu-O chain do not play an important role in high T_c superconductivity.

The Superconductivity and Anomalous Magnetization of the $\text{Ti}_4\text{Ba}_3\text{Ca}_3\text{Cu}_4\text{O}_y$

40090024C Beijing DIWEN WULI XUEBAO
[CHINESE JOURNAL OF LOW TEMPERATURE
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[English abstract of article by Cao Xiaowen, Huang Sunli, and Zhang Fengying, Institute of Plasma Physics, Academia Sinica, Hefei, Long Xiangyun, Peng Qiuyun, Qi Zhiwei, Wu Yusheng, and Fang Junren, Changsha Research Institute of Mining and Metallurgy, Zhang Weijie, Mao Xianglei, Liu Hongbao, and Zhang Yuheng, Department of Physics, University of Science and Technology of China, Hefei]

[Text] Two superconducting phases, i.e. the 100K phase and the 120K one, exist in the $\text{Ti}_4\text{Ba}_3\text{Ca}_3\text{Cu}_4\text{O}_y$ oxide superconductor. The zero resistance, T_c is 119K at 10 mA measuring current. The DC magnetization results show that at 77K the magnetization is nearly reversible in the applied field of above 2200 Oe and the forgen flux density is 11.6G. So our sample is still of a weak pinning type H superconductor. The experimental result of Meissner effect shows that 61 percent of Meissner signal results from the 120K phase and the rest from the 100K phase. It has been found that there exist a great deal of weak-link superconductivity and it results in a proximity effect superconductor in our sample. This can be seen by

the comparison between the upper and lower limits of the superconducting volume fraction, the measurements of resistance transition at both various applied fields and measuring currents, and the analysis of anomalous magnetization. The magnetization characteristics and some parameters of the proximity effect superconductor have been obtained, and the $H_{c2}(T)$ of this superconductor has been studied.

The Magnetization and H_{c1} of the High T_c Oxide $\text{Bi}_{2-x}\text{Pb}_x\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_y$ Bulk Superconductors

40090024E Beijing DIWEN WULI XUEBAO
[CHINESE JOURNAL OF LOW TEMPERATURE
PHYSICS] in English Vol 12 No 3, May 90 p 229

[English abstract of article by Cao Xiaowen, Huang Sunli, Wen Haihu, and Zhang Fengying, Institute of Plasma Physics, Academia Sinica, Hefei, Zhang Weijie, Liu Hongbao, and Zhang Yuheng, University of Science and Technology of China, Hefei]

[Text] Meissner effect measurements have shown that there are two superconducting phases, 110K phase and 85K phase, in the high T_c oxide $\text{Bi}_{2-x}\text{Pb}_x\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_y$ bulk superconductors, that the volume fraction of 110K phase is much larger than that of 85K phase, and that the diamagnetic transitions begin at the temperature of about 103K. The magnetization results of various samples at 77.3K have shown that H_{c1} approximately equals 28 Oe for the samples with x equal to or less than 0.3 and $H_{c1} = 25$ Oe for x greater than 0.3. The magnetization results of the sample with $x = 0.3$ in different temperatures show that there is linearity between H_{c1} and T, and $dH_{c1}/dT = -1.07$ Oe/K. The existence of the two superconducting phases makes the magnetization peak width, and the widening extent is dependent on the volume fraction of the 85K phase.

Study on Zero Resistance at 118K in (Bi, Pb)-Sr-Ca-Cu-(O, F) Superconductor

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[CHINESE JOURNAL OF LOW TEMPERATURE
PHYSICS] in English Vol 12 No 3, May 90 p 218

[English abstract of article by Gao Xiaohui, Wu Xiaolin, Yan Hui, and Yin Zhoulan, Applied Quantum Chemistry Research Section, Central-South University of Technology, Changsha, Lin Caidong, Fu Yingsheng, and Xie Wuxi, Power Metallurgy Institute, Central-South University of Technology, Changsha]

[Text] (Bi, Pb)-Sr-Ca-Cu-(O, F) superconductors of transition with onset at 125K and zero resistance at 118K have been synthesised successfully with CuF_2 as one of the components. The effect of fluorine on sintering technique and the superconductivity of the sample have been investigated. The best doped ratio in (Bi, Pb)-Sr-Ca-Cu-(O, F) superconductors has been obtained through our experiments. The contribution of fluorine to

kinetic process of high- T_c phase growth has been discussed. The results of X-ray powder diffraction show that only two phases exist in this superconductor, a low- T_c 85K phase and a high- T_c 110K phase. All of the X-ray diffractive peaks can be indexed in the forms of orthorhombic cell with the constants of lattice $a = 5.398$ angstrom, $b = 5.376$ angstrom, $c = 30.742$ angstrom (85K phase) and $a = 5.400$ angstrom, $b = 5.407$ angstrom, $c = 30.088$ angstrom (110K phase). No fluoride or other impure phases are found in the system.

Relation Between the Change of Oxygen Deficiency and Oxygen Hole and the Transition of Structure for $Y_1Ba_2Cu_3O_{7-\delta}$

40090024F Beijing DIWEN WULI XUEBAO
[CHINESE JOURNAL OF LOW TEMPERATURE
PHYSICS] in English Vol 12 No 3, May 90 p 236

[English abstract of article by Su Wenhui, Jin Changqing, He Lanying, Wang Yifeng, and Liu Hongjian, Department of Physics, Jilin University, Changchun, Long Xiang and Gao Zhongmin, Center of Analysis and Measurement, Jilin University, Changchun]

[Text] The changes of structure and oxygen deficiency of $Y_1Ba_2Cu_3O_{7-\delta}$ as a function of temperature have been studied by kinetical high temperature X-ray diffraction in air, nitrogen, oxygen and vacuum (10^{-3} torr). The influence of different atmosphere on the equilibrium between lattice oxygen and absorbed oxygen was considered. The relation of oxygen deficiency and structure transition has been studied. According to the conclusion about the electron transfer between Cu and $Cu^{(II)}$, the relation between the average oxygen hole n_h in Cu-O layer and the structure transition was found. O equal to or less than δ equal to or less than 0.25, 0.25 equal to or greater than n_h equal to or

greater than 0.125 is the stable region of superconducting orthorhombic phase. The density of oxygen hole is approximately $(1.44 - 0.72) \times 10^{21}/cm^3$, 0.25 equal to or less than δ less than 0.5, 1.25 equal to or greater than n_h greater than 0, the transition region, O (orthorhombic) to T (tetragonal); 0.5 equal to or less than δ equal to or less than 1, $n_h = 0$, the stable region of non-superconducting tetragonal phase. Therefore, the negative 2 valence will not always be taken for oxygen anions except for non-superconducting tetragonal phase.

Millimeter Wave Surface Impedance of $YBa_2Cu_3O_{7-x}$ Sheets Measured by a High- T_c Superconducting-Dielectric Resonator at W-Band

40090024A Beijing DIWEN WULI XUEBAO
[CHINESE JOURNAL OF LOW TEMPERATURE
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[English abstract of article by Zhou Shiping and Bao Jiashan, Shanghai University of Science and Technology]

[Text] Temperature dependence of millimeter-wave surface impedance of $YBa_2Cu_3O_{7-x}$ sheets was measured by using a high- T_c superconducting-dielectric resonator (SDR). The SDR consists of a sapphire tube loaded with two endplates of $Y_1Ba_2Cu_3O_{7-x}$ sheet. It is very suitable for measuring the surface impedance of high- T_c oxide superconductors at w-band. The surface resistance of YBCO samples, R_s , drops rapidly below 80K as the temperature decreases, but the excess surface resistance is observed at relatively low temperatures (e.g., $t = 0.2 = T/T_c$). This is not in accord with the predictions of the BCS theory. A new method for determining temperature dependence of penetration depth is proposed. The fitted curve is $\lambda(t) = \lambda(0) \times (1-t^2)^{-1/2}$ with $\lambda(0)$ being about 1310 angstroms.

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